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32d Congress, 1st Session. [SENATE.] Ex. Doc. No. 3.

ANNUAL REPORT

OF THE

SUPERINTENDENT OF THE COAST SURVEY,

SHOWING

THE PROGRESS OF THAT WORK

DURING

THE YEAR ENDING NOVEMBER, 1851.

WASHINGTON:
ROBERT ARMSTRONG, PRINTER.
1852.

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LETTER

FROM

THE SECRETARY OF THE TREASURY,

COMMUNICATING

The report of the Superintendent of the Coast Survey, showing the progress of that work during the year ending November, 1851.

TREASURY DEPARTMENT,
December 5, 1851.

SIR: I have the honor to submit, for the information of the Senate, the accompanying report, made to the department by Professor A. D. Bache, Superintendent of the Coast Survey, showing the progress of said work during the year ending November, 1851. All of which is respectfully submitted.

THO. CORWIN,
Secretary of the Treasury.

Hon. W. R. KING,
President of the Senate.

REPORT OF THE SUPERINTENDENT OF THE COAST SURVEY.

COAST SURVEY STATION,
Cape Small Point, Maine, November 5, 1851.

SIR: I have the honor to submit the annual report, required by the regulations, of the progress of the survey of the coast of the United States, for the information of the department and of the President and Congress.

The appropriation asked for the last fiscal year provided for work on portions of the whole extended coast of the Atlantic, Gulf of Mexico, and Pacific, in the proportions deemed necessary for the wants of commerce and navigation, or desirable from the different stages of progress at the several points, or economical in reference to the distribution of the parties according to the best working seasons.

The plan which has for some years been pursued, with the approval of the executive and legislative authorities, has been steadily adhered to. The coast of the Atlantic and Gulf of Mexico, extending over

nearly nineteen and a half degrees of latitude and thirty and a half of longitude, is divided into nine sections of nearly equal extent of shore line, following the minute indentations of the coast; and the survey is begun in each, and advanced each year, as far as the means appropriated permit. A base line measured in each section, and observations made for latitude and azimuth at appropriate points, furnish data for the preliminary maps and charts of the sections, without waiting for the completion of the whole work; while the system provides for the joining of the parts and the verifications, which are necessary in all extended surveys, and without which the accuracy desirable and attainable would by no means be reached. To derive matured fruit from such a plan, it must be steadily prosecuted to its completion. It is most advantageous for reasons which I have, in former reports, dwelt upon in detail. It avoids exclusive attention to one part of the coast and neglect of the rest, permitting a ready adaptation to general or local wants. It accommodates itself to the facilities or difficulties presented by the different natural features of the coast, by which the rate of progress of the whole work in different places, or of different operations in the same region, varies. It facilitates the division of labor, which is an important element of progress and of economy; and permits the execution of each operation at the best season or period, which is equally important. It is not less flexible in lending itself to the scientific, than the practical and economical requirements of different cases.

What it is capable of doing when steadily followed out, is illustrated by sections three and four, in which, while the necessary data for maps, charts, and sketches have been furnished from year to year, the triangulations have been advancing—one from Kent Island base, southward, in Maryland and Virginia; the other from the Bodie's Island base, North Carolina—until they are now within less than fifty miles of each other. Two seasons will enable us to join them, and then the results will verify each other.

Similar plans are in progress for each of the sections, requiring only careful adjustment to the features of the coast to insure, finally, all the perfection of a geodetic survey. The continuance of the fostering care of the Executive and Congress in the uninterrupted execution of these plans, will bring them certainly to maturity. The time of completion will depend upon the means which a judicious economy may consider available to this portion of the public service. Every increase of the appropriation, up to the point when the work would become unwieldy, and unity of design and execution would be sacrificed to rapidity, is attended with not only a corresponding decrease in time, but with more than a proportionate decrease. I have considered it a duty, while adhering generally to the limits which Congress has determined at a particular time to appropriate, to represent to the Treasury Department the cases in which an increase is demanded for the successful progress of different parts of the survey.

The plan for prosecuting the survey of the western coast, so as to meet the wants of a commerce increasing with a rapidity which has no precedent, and the peculiar condition of the country in other respects, was presented in my last report, and is briefly repeated in this. It will require, for a few years, the application of larger means than will after-

wards be needed. Until we can place that coast at least on a footing in respect to surveys with that which resulted from efforts in colonial times, in respect to the Atlantic coast, I am convinced that duty requires me to urge the supply of more than ordinary means to meet an extraordinary case. On what coast before has commerce been developed, from the outset, by the aid of steam?—altering all the usual relations of time, draught, and course, and I may add, of value from a single loss. When has it before occurred that a locality, marked on charts four years since as a mere trading establishment for skins, should have grown into a city, the fourth—in such a country as the United States—in the amount of revenue collected for the general treasury? We have assuredly not yet come up to the requirements of such a commerce.

I have before remarked that the plan of the survey furnished data for immediate use. In fact, between one-fourth and one-third of the annual appropriation is devoted to what is classed as office work, consisting in computation, reduction, drawing, engraving, electrotyping, printing, and publishing. Usually, the publication of the results of a work is estimated for separately; but here it goes to swell the total amount. It is advantageous not to separate the two sets of estimates, as it permits the adaptation of the field and water work and of the publication to each other in due relation, notwithstanding the varying circumstances which cannot be anticipated, and which are sometimes beyond control, in changing the amount of one or the other. When a work, from its magnitude, necessarily occupies a number of years, to postpone the publication of its results until its completion is to deprive the public of all advantage from it until the highest is attainable. We have proceeded upon the opposite plan—that of endeavoring to give results as fast as they can be obtained. Not to give those as final which are really only approximate, but stating the degree of approximation; to give them in such a shape as will make them immediately useful, increasing the refinements in the form in which they are presented as the increased accuracy of the determinations permits. The sketches intended to give information to nautical men and others, which accompanied my report in 1849, were fifteen in number, while in the present report they are thirty-three; and eight notices to mariners, some of them very extended, have been published in the course of the year. This not only diffuses the information derived from the survey while it is fresh, but it reacts powerfully on the work itself, giving a strong but healthful stimulus to those who are engaged in it by enabling them at once to realize a portion of the credit of their labors. It improves the details, too, by presenting them in such a shape that their merits or defects can be fairly weighed. It fixes responsibility, and gives immediate credit for well-executed work. I would even go further than this, by publishing the data derived from observation, and, when they admit of it, the observations themselves. I am satisfied that the additional expenditure which would thus be required would repay itself many times in the efficiency of the work, the security from loss, the diffusion of information as to methods and results of observation, and in the great facility for such publication while the persons by whom the observations are made are still actually occupied in the same work, and all the minute particulars are fresh in their minds. This plan is much to

be preferred to that of deferring the publication until the close of the survey.

With the present report will be presented a list of geographical positions, 3,240 in number, derived from the preliminary calculations of the work. The degree of accuracy which has been reached in the different sections will be explained when considering the details. It will be found that improved methods of determining the latitudes by observation have been employed; that the various methods which astronomy and geodesy furnish for determining longitudes have been applied; and that, in addition to the usual ones, we have introduced for the first time, as part of a geodetic work, the determination of difference of longitude by the telegraph. This list will receive revision from time to time; but its publication now will afford very useful data to geographers, surveyors, and even to astronomers. It will be followed by others relating to magnetism and the tides. This is a new feature in the annual report, and, with the extension of the number of sketches, will add materially to the interest which it would have as a report of progress.

For the development of the plans of office work as facilities have been afforded by the additional appropriations, the urging to completion this list of geographical positions, and the increased rapidity of publication, the coast survey is indebted mainly to the zeal and industry, guided by knowledge and intelligence, of Brevet Major I. I. Stevens, of the corps of engineers, in acknowledging which, in connexion with the remarks on the speedy publication of the results of the survey, I feel that I am doing simply an act of justice.

The organization under which the survey is conducted has been so repeatedly explained and approved, that it needs merely a passing notice. In 1843, a board was convened, under authority and by direction of Congress, embodying in its constitution all the experience which could be furnished by the history of the survey, by consisting of civilians and officers of the navy who had served in it, and officers of the army who had served in it, or were professionally conversant with its details. This board provided for the continuation of the organization which both reasoning and experience found to be the most effective, combining the scientific and practical acquirements of civilians, officers of the army, and officers of the navy, in the work. The survey was recognised as primarily for the benefit of commerce, but having important connexions with defence;—providing for a permanent nucleus of civilians, and for the detail of officers of the army and navy, necessarily varying from time to time in numbers and persons as the exigencies of the military or naval service prevailed over the wants of the survey;—recognising on the one hand that this branch of applied science was a profession requiring long and careful study, and on the other that the practical skill of the naval officer, or the West Point education of the army officer, might most usefully contribute to the progress of the survey;—not excluding the man of science from one of the highest works of applied science which his country has engaged in, nor the army or navy officer from an appropriate sphere of usefulness;—not exposing the work to the contingencies of being arrested by even an alarm of war, nor of excluding the officer of the army or navy from a position in it while his services could be spared from other duty;—not organ-

izing a permanent corps to execute a temporary work, nor yet making the survey a mere school by which all its operations would bear upon them the stamp of the beginner;—combining, as is appropriate to our institutions and our time, the knowledge and experience, wherever to be found, necessary to render its execution creditable to the character of the country. Such an organization could not exist under either the Navy or War Department, and, as most appropriate to a work of commerce, was placed under the direction of the Treasury Department.

Circumstances have forced the closest scrutiny of the organization, progress, results, economy—in short, of every particular relating to the coast survey; and it must be gratifying to the Executive and legislature, who have done so much for its advancement, to find the uniform approval from the highest authorities, both scientific and practical, at home and abroad, which this scrutiny has developed. In this result is to be found the best guaranty, that, if this fostering care is continued, the survey of the coast will be properly completed in a reasonable time, and with a reasonable outlay of means. Within the year, the Geographical Societies of London, Paris, and Berlin, have given the most unequivocal evidence of their interest in, and approval of, the character of the coast survey.

In former reports I have compared the results of the survey on different scales of appropriation with each other. At first, on presenting the plan for its enlargement, it was difficult to convince those upon whom the increase depended that economy would be produced. Each step rendered this less difficult by furnishing positive data in figures. The present scale presents for the Atlantic coast a result of three and a half to one, with an expenditure of less than two to one. (See report of 1850.) So, also, it turns out that the operations which conduce to the essential scientific accuracy of the work are not those which tell most in the sum total of the expenditures; and that while, without those, the character of the work on land would be unworthy of the country, and the hydrography mere reconnaissance, they do not double the cost of the land parties. I have gone into these computations in the report of 1848, and have shown that the cost of measurement of base lines, the astronomical work, and the triangulation, was less than the cost of the topography which was essential to the delineation of the coast; while, in reference to the accuracy of the work, their importance cannot be over-estimated. An examination of the geodetic method, as compared with the mode in use in the Land Office of the United States, showed an aggregate cost per lineal mile for all operations, without the cost of drawing, less than the maximum allowed for the land surveys; and with the finished drawings, a cost but little exceeding it—($11 25 per lineal mile. See report of 1848.) As compared with the cost of foreign surveys, the Secretary of the Treasury has shown (see repor, Senate Doc., Ex. No. 26, 1849) that this work has largely the advantage in point of economy—an advantage which I apprehend woudl have been lost to it, if, as in some of the organizations abroad, a permanent corps, deriving its emolument from other service, and only incidentally employed in this, had been organized to execute it; or if intrusted to a body composed entirely of changing elements, not devoted professionally to scientific pursuits.

The lowest estimate which I can make of the progress of the work on the coast of the Atlantic and Gulf of Mexico, is, that at the commencement of this fiscal year more than three-eighths had been completed. This estimate is made from a careful examination of the progress in the different sections. The shore-line to be surveyed has been estimated from the best data which could be obtained; and it is easy in every section, except those where the work has been introduced very recently, to estimate with considerable accuracy its rate of advance. A general reconnaissance has been begun which will much facilitate this calculation, and enable us to introduce the elements of facility or difficulty of survey into the estimates for the time of completion of the different sections. The greater expenditure necessary for the maintenance of each party in the southern sections must enter also into such an estimate, if the total amount to be expended is considered as final. In some portions of the operations, as for example the topography, the smaller number of details necessary in the southern sections diminishes the time required for the survey of a given extent of shore-line, or a given area; but the expenditure in the whole is considerably greater than in the others. The present rate of annual progress is certainly between four and six per cent. of the remaining shore-line.

The time when the work is to be completed, I am aware, is of less consequence than the manner in which it is done. If executed by any but the best methods, it will undoubtedly be done over at some future day. We have not yet found a portion of the coast to which the geodetic method is inapplicable. There may be such, and then we shall not be without resource, but at present we are not compelled at any point to abandon the most exact methods. The mountains of Maine, New Hampshire, and Massachusetts, and the hills from Maine to Maryland, afford every facility for triangulation; the wide expanse of Chesapeake bay in Maryland and Virginia, and of Albemarle and Pamplico sounds in North Carolina; the sea-islands and passages of South Carolina and Georgia; the keys and main of Florida, Mobile bay, and the islands off the coast of Alabama, Mississippi and Louisiana; the bays and prairies of Texas; the bare hills of California; the hills and sounds of Oregon,—are all characteristic features of the several parts of the coast, requiring only to be recalled to the mind to indicate the easy application of the geodetic method to a survey of the coast. The points being well determined and marked on the land, and the shore-line traced, the hydrography is readily executed with the requisite nicety.

Every part of these operations must go on according to a system, or the result fails in completeness, or in economy. This is secured by a general plan of operations, the details of which are submitted by the Superintendent to the Treasury Department, annually; and which, when approved, are executed according to instructions given as to the scientific details by the Superintendent. The modes employed are thus as uniform as can be obtained from the operations of different individuals. The plan of distribution given in Appendix No. 1, is in execution of the "Directions" thus approved by the Secretary of the Treasury in March, 1850, and 1851. At the close of each season,

the assistants report the results of their work, which are embodied in the notices of the several operations in the annual report of the Superintendent.

The resolution of Congress, under which the plan of organization of 1842 was drawn up, required that as many officers of the army and navy as practicable should be employed: the army officers on the land part, and the navy officers on the water part, of the work. The number of army officers was gradually increased from 1844 to 1848, when it had reached fourteen, namely, five staff and nine line officers. These were necessarily removed, with but few exceptions, on the breaking out of the Mexican war; and but for the connexion of civilians with the survey, trained to its operations, the land work would have ceased. Informal notice was given at one time that there might be a necessity for withdrawing also the officers of the navy; but, as the war was not a maritime one, we did not suffer that loss. Soon after the war closed, application was made for the detail, again, of officers of the army, which was met by a request that formal action might be postponed until the regiments were at the posts assigned them. This was in 1848. In 1849 the application was again made and declined, and in 1850 was renewed; and from time to time officers have been detailed until the number now attached to the survey is eleven—namely, four from the engineers and topographical engineers, and seven from the line; and two applications remain not finally disposed of. The names and rank of these officers, and dates of their detail, are given in the Appendix No. 2. Their services have already told in the execution of the operations of the past season, and will be of still further value in those of the next, as they all obtain the necessary experience in the practical operations of the survey now possessed by some.

The number of hydrographic parties has been increased under the injunction of the law, as their services could be rendered available. It now consists of ten parties, of which four are occupied in sections where the seven months which include the summer are most profitable for work afloat; one where the work is done in the autumn and spring; four where the seven months including the winter constitute the best working season; and one is employed during the greater part of the year. This past summer, two of the parties have been transferred from southern sections, at the termination of their working season, to do duty for a time in a more northern one. The average number of officers in each party during the season, afloat, is five. On closing their work afloat, three of each party are allowed by the Navy Department to repair to the office for reducing their hydrography; which, from its nature, cannot be so well done in any other way as under the immediate inspection of those who have executed it. During a brief period in the spring or summer, and during the autumn, the seasons of active employment overlap; but the interval is not considerable between the closing of operations in one set of sections and the beginning of those in the others. The whole number of navy officers on coast survey duty was *fifty-two* on the 1st of March, 1851; and on the 1st of September, 1851, was *sixty-six*. There are on duty afloat, now, when the parties are full, fifty-five officers, and on office duty eleven. The names of the officers detailed are given in Appendix No. 3 and No. 3

bis. The Coast Survey provides the vessels for these parties, keeps them in repair, fits them out, and provides for current surveying expenses from the appropriation. When steam is used, the coal, wood, oil, &c., are provided by the coast survey. The engineers attached to the steamers are from the navy, and the names of those now on service in the Coast Survey are given in Appendix No. 4 and No. 4 *bis.* The transportation of officers is paid by the survey, and during the past year has fallen heavily upon it: officers being directed to report by letter, and not, as heretofore, in person, to the Secretary of the Treasury, so that their transportation in joining has been paid from the appropriation for the survey, and not from the naval appropriation. Draughtsmen are provided, while the parties are in the office, from the coast survey appropriation, being allowed as clerks to the chiefs of parties only when afloat. I have found it necessary to include additional items for these expenses in the estimates for next year. Nearly half the officers of each party being detached from the survey as the parties take up their office work, that afloat is always resumed with the disadvantage of inexperience; which makes the work less valuable and more costly, and sometimes prevents the execution, by the chiefs of parties, of as much as they would desire to accomplish.

While the obligations of the survey to the officers of the army and navy serving on it are freely and fully acknowledged, it should not be forgotten that, on the other hand, the work serves as a school of practice for them, and thus gives while it receives.

The statistics from the records of the Coast Survey office, furnished in the table Appendix No. 5, show the large amount of work done, and of results collected, up to the beginning of 1851. The number of original topographical maps is 301, consisting of 483 sheets; of hydrographical maps 735; and of reduced maps and charts 220. The extent of shore line already surveyed is 11,873 miles.

A list of the discoveries and developments made on different parts of the coast is also printed in the Appendix, (No. 6.) As a summary of these was given in my report of last year, I do not propose at this time to repeat it, but merely to call attention to the new results obtained this year, viz: those upon the Nantucket shoals, as shown in the sketch accompanying this report; the minute survey of the rocks in Hellgate and in Buttermilk channel, to mark the changes effected by blasting; the thorough examination of the Chincoteague shoals, near the entrance to the Chesapeake; the examination of the Frying Pan shoals near Cape Fear, and of Cape Fear entrance; the survey of the harbor of refuge of North Edisto, South Carolina; of Tybee bar and Savannah harbor; of Key West; of the mouths of the Mississippi; and of Humboldt and Trinidad bays, in California.

The importance of circulating the sketch of Nantucket shoals among our navigators is very great; as, notwithstanding that frequent publications have been made in regard to them, vessels still incautiously approach too near them. Within the past summer one of our national vessels touched upon Davis's New South shoal, the position of which was published in 1846. The extent of the Chincoteague shoals and of the Frying Pan shoal appear to have been very erroneously laid down hitherto, and are now given, as well as the depth of water upon them,

in sketches C No. 3, and D No. 8, appended to this report. The harbor of North Edisto, to the south of Charleston, and that of Bull's bay, to the north, furnish safe refuges to vessels finding themselves to leeward of Charleston entrance in bad weather. On this account I have republished, with the present report, the sketch of Bull's bay (E No. 6,) to accompany that of North Edisto, (E No. 7.) The comparison of the present shore line and channel of the entrances to the Mississippi through the Northeast Pass, and the Pass à l'Outre, with the survey made in 1839, is highly instructive, and will be noticed more in detail in the hydrography of Section VIII. The small number of harbors on the western coast, between San Francisco and Columbia river entrance, renders the contribution of the surveys of Trinity bay and Humboldt harbor of the greater relative importance. The charts of the western coast reconnaissance, in three sheets, were engraved, printed and published in twenty working days from the time the drawing was received at the office of the Coast Survey.

As the hydrography advances, tidal stations at important points are occupied, and continuous observations made. Self-registering tide gauges are constructing at the office, which will much facilitate the making of these observations. The results obtained in the Gulf of Mexico from the discussion of the tidal observations are of great interest, leading to the establishment of the laws by which the phenomena are regulated, and bringing within the reach of computation phenomena which were supposed by navigators to be due to the effect of the prevailing winds. Provision has been made for extending these observations during the coming season. I have placed in the Appendix to this report (Nos. 7 and 8) a paper read by me before the American Association for the Advancement of Science, on the tides at Cat island, in the Gulf of Mexico, and on a mode of representing the results of observations of tidal currents; (Sketches H, Nos. 2 to 6, inclusive.)

The observations for longitude, by astronomical observations, by the transportation of chronometers, and by telegraph, have been continued at various points; and notices will be found of them, in connexion with the several sections of the coast to which they belong. The discrepancy, which I have stated in previous reports, between the results of longitude by moon culminations and occultations, has been greatly reduced by the researches of Myers F. Longstreth, of Philadelphia; and the re-computation of our results, with his coefficients of the lunar theory, will be in the highest degree important. We expect, in this matter, to receive important aid from the Nautical Almanac office, under the direction of Lieutenant Charles H. Davis, United States navy.

An account of a second chronometer expedition between Liverpool and Cambridge is given in Section I. At Cambridge, the transits are generally reduced by what has been called by Professor Airy the "American method," as having originated and been brought to its present advanced state in this country; Mr. Bond using an electrical clock and "spring governor," of his invention, for marking the time at Harvard observatory. It is gratifying to national feeling to be able to state that the clock and governor made for the Coast Survey, by Professor Bond and his sons, has received one of the five honorary medals awarded by the commissioners of the late Industrial exhibition.

Charleston and Savannah, (see Section V,) Cambridge and Bangor, (see Section I,) have been connected for difference of longitude by telegraph, and our work has been joined in the same way with that of the British government in Nova Scotia.

Observations for declination of stars, giving irregular results for latitude, were made by Professor Mitchell, of Cincinnati, with the new declination apparatus of his invention, in 1849; and it is very desirable that they should be continued, with the apparatus as improved. This method has undergone the close scrutiny, and has received the approval, of the American Association for the Advancement of Science. A description by Professor Mitchell is given in the Appendix, No. 9.

The work of two more seasons will nearly, or quite, complete the determinations necessary for the appropriate length of the arc of the meridian passing down the Chesapeake, over the space where the measurement of Mason and Dixon was supposed by some to have indicated irregularities in the figure of the earth—while by others the measurement itself was rejected.

The telegraphic connexion between New Orleans and Washington for longitude will, it is expected, be completed next year, which will give the measurement of a portion of a parallel on the Gulf of Mexico, hereafter to be materially extended by the ordinary operations of the survey.

The examination of the Florida reef, made at my request, last winter, by Professor Agassiz, has developed, as was anticipated, the subject of its origin, growth, present character, and probable future progress, and in the most masterly manner. As it is desirable to give the results entire, in full detail, with drawings, and in an appropriate form, I have suggested that it be made a separate communication by the Treasury Department to Congress. In the mean time, I present from it a description of the topography of the keys and reef, which forms one of the chapters, with extracts from other portions of the report, in the Appendix, No. 10. The scientific details are so admirably interwoven with the body of the practical conclusions, that it has been found impossible to present portions of the report without injury to the whole.

One hundred and fifty-eight maps, charts, and preliminary sketches, are now in the hands of the draughtsmen and engravers, or have been published; a list of which is placed in Appendix No. 11, showing the number published, engraved, and in progress. Of these, the following have been engraved during the year to accompany this report, besides nineteen sketches of progress.

I.—*General hydrographic sketches, &c.*

1. Nantucket shoals.
2. Current chart of Boston harbor.
3. Progress of Sandy Hook.
4. Middle Ground, entrance to Chesapeake.
5. Hatteras shoals.
6. Hatteras inlet.
7. Beaufort harbor.
8. Frying-pan shoals.

9. Savannah city.
10. Savannah entrance.
11. Bull's bay.
12. North Edisto.
13. Florida peninsula.
14. Cedar keys.
15. Preliminary chart of Key West.
16. Horn Island pass.
17. Delta of Mississippi.
18. Pass Christian.
19. Mobile bay.
20. Five diagrams of tides at Cat island.
21. Mare Island straits.
22. Trinidad bay.
23. Humboldt bay.
24 to 26. McArthur's reconnaissance chart, 3 sheets.
27. Mouth of the Columbia.

II.—*Sketches for location of light-houses, &c.*

1. Holmes's Hole.
2. Beacon ranges, New York.
3. Fishing battery, Chesapeake.
4. Mosquito inlet.
5. Rebecca shoal.
6. Aransas pass.
7. Galveston bay.
8. San Diego.
9. Point Conception.
10. Point Pinos.
11. San Francisco entrance.
12. Humboldt bay.
13. Cape Hancock.

Hydrographic notices have been published by authority of the Treasury Department, and distributed within the past year, in relation to the following localities and subjects, important to the navigating interests of the country:

1. On the draught of vessels which can enter the south channel of the Columbia river, Oregon.

2. Sailing directions for entering the Columbia river as far as the harbor of Astoria.

3. Description of the islands and rivers between the harbor of Monterey and mouth of Columbia river.

4. Correction in the position of the Farallones and Point Lobos, entrance to San Francisco bay.

5. Information in relation to North Edisto harbor of refuge, South Carolina.

6. Information in relation to San Diego, Humboldt, and Trinidad harbors, western coast.

7. Extract from Lieutenant Commanding Alden's letter, in relation to Humboldt harbor and Trinidad bay.

8. Report of the latitude and longitude of Point Conception.

The list of geographical positions appended to this report (Appendix No. 12) contains the trigonometrical points of the coast survey determined up to July, 1850; and also the positions of a number of permanent objects determined by means of the plane table. The list is accompanied by sketches showing the positions of the points referred to. A preface explains generally the divisions of the coast which are referred to; and, in a popular way, the mode of determining the distances, latitudes, longitudes, and azimuths, which the table contains, their connexion through the figure of the earth, and their variation due to irregularities of figure and density. The degree of approximation which may be expected from the results of the computation, according to the stage of progress towards the final conclusions, is pointed out. The arrangement of the different parts of the table is also fully explained. Great care will be required in the revision of the printing of this useful list; and even with it, errors must be expected, which, however, a subsequent impression will in a considerable degree correct.

The act of 3d of March, 1851, required an important class of duties of the Superintendent of the Coast Survey, namely: to provide for the examination of the sites of light-houses, beacons, buoys, &c., for which appropriations were made, and which, in the opinion of the Fifth Auditor, required examination.

"Sec. 2. *And be it further enacted*, That if such person as the Secretary of the Treasury shall designate shall report, in any of the cases herein provided for, that preliminary surveys are necessary to determine the site of a proposed light-house, or light-boat, beacon or buoy, or to ascertain more fully what the public exigency demands, the Secretary of the Treasury shall thereupon direct the Superintendent of the survey of the coast of the United States to perform such duty on the seaboard, and the colonel of the corps of topographical engineers to perform such duty on the northwestern lakes.

"Sec. 3. *And be it further enacted*, That the officer so directed shall forthwith enter upon the discharge of the duty; and, after fully ascertaining the facts, shall report: First, whether the proposed facility to navigation is the most suitable for the exigency which exists; and, second, where it should be placed if the interests of commerce demand it; third, if the thing proposed be not the most suitable, whether it is expedient to make any other kind of improvement; fourth, whether the proposed light has any connexion with other lights, and, if so, whether it cannot be so located as to subserve both the general and the local wants of trade and navigation; and, fifth, whether there be any, and if any, what other facts of importance touching the subject.

"Sec. 4. *And be it further enacted*, That all such reports shall, as speedily as may be, be laid before the Secretary of the Treasury; and if such as to authorize the work, without further legislation, he shall forthwith proceed with it, otherwise such reports shall be laid before Congress at the next ensuing session; but, in all cases when the person designated by the Secretary of the Treasury, under the second section of this act, does not report such preliminary examination as expedient, the provisions of this act shall, without delay, be carried into execution."

The Secretary of the Treasury, in conformity with the first clause of the second section of the act quoted above, called upon the Fifth Auditor to report the cases in which preliminary surveys were necessary to determine the sites of the objects provided for and enumerated in the act. He reported that, with three exceptions, he had "no knowledge of the reasons on which the several appropriations were made," and that "the necessity for the examination was apparent from the many lights on the coast and lakes, and the fact that on some parts of the coast the lights are now so numerous that it is impossible to distinguish one from another, and they are hence becoming a nuisance." (See Appendix No. 14, *bis*.)

In pursuance of the report of the Fifth Auditor, the Treasury Department gave me instructions on the 29th of March last, (see Appendix No. 13,) to proceed with the examination on the Atlantic coast, the Gulf of Mexico, and Pacific, including thirty-six localities from Maine to Texas, and on the western coast from Humboldt harbor, California, to the mouth of the Columbia river, Oregon.

Instructions, more or less detailed, were issued by me, as early as practicable, to the assistants of the coast survey operating in or near these localities, directing surveys, reconnaissances, or examinations, as the cases required. Upon these reports the decision required by the law was made, and all the facts of the case communicated for the information of the department. These valuable reports of the assistants, usually accompanied by maps or sketches, or referring to the published maps of the coast survey, are embodied in the Appendix to the present report, under the heads of the different sections of the coast. The results are also briefly stated in the same connexion in the body of the report.

A detailed list of the subjects of my reports, in tabular form, is presented in the Appendix, (No. 15,) including the section of the survey in which the work was done; the name of the State, the special locality, the name of the object appropriated for, the officer by whom the examination was made, the date and nature of my reports. The table also contains the results of examination for sites of light-houses, &c., required under the act of Congress of the previous year, viz: those at Fort Point in the bay of San Francisco, at Point Conception, Point Pinos, near Monterey, Point Loma, near San Diego, California, and Cape Hancock or Disappointment, mouth of Columbia river.

The only objects remaining not reported upon are a light-house and fog-signal at Umqua, in Oregon, and two on the coast of North Carolina, the sites for which are under examination, and upon which reports may soon be expected.

The examinations were made in eleven States, viz: Maine, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Maryland, North Carolina, Florida, Texas, California, and in Oregon Territory. And the objects reported upon are as follows: light-houses, eighteen; harbor or "bug" lights, three; beacons, six; light-boats, three; buoys, thirty-three; spindles, two; fog-bell, one; fog-whistles, four; floating bell-beacon, one. The special localities of these objects are given at length in the table, (Appendix No. 15,) and the details of the examinations are treated of under the heads of the different sections of the

coast, and in the reports of the hydrographic assistants of the coast survey, which are given in the Appendix. The information embodied in these reports has been obtained through the facilities furnished by the distribution of the parties of the coast survey in all the sections of the coast, at a merely nominal expense—less indeed than one thousand dollars—while the information obtained of a reliable sort from the assistants of the work, will effect a saving of many thousands. The zealous and efficient assistant in charge of the office of the Coast Survey has caused the drawings required to illustrate the reports to be promptly made and forwarded to the department. Nor have the steps taken to procure the reports interfered in any case, that I am aware of, seriously, with the duties of the Superintendent and assistants, being rather incidental than foreign to the other duties in which they are engaged.

In July last a letter was addressed to me by the secretary of the Light-house Board, created by act of Congress of March last, requesting inquiries of the chiefs of hydrographic parties of the coast survey in regard to light-houses and accessories on the coast. I addressed a circular to the officers thus referred to, and have transmitted their replies to the board. Several of their replies contain recommendations of new light-houses, beacons, buoys, &c., which are referred to in their annual reports. I have embodied them with other recommendations of assistants in the survey, and have given extracts relating to them from the reports. (Appendix, No. 16.) They embrace objects in the States of Maine, Massachusetts, New York, North Carolina, South Carolina, Florida, Texas, and California. (For a tabular list of these objects see Appendix, No. 17.)

The object of my annual report is twofold—one, to give an account of the progress of the survey; and the other, to furnish information which has been derived from it, and which may be of interest to commerce and navigation. The preliminary statements are intended, very briefly and in a general way, to call attention to the most prominent points relating to either of these objects; to give a condensed statement of the progress of each part of the work, an outline of the progress which may be expected during the ensuing *fiscal* year, and the estimate of its cost. Following the divisions of the coast into sections which has been adopted in the work, I next give a more detailed account of the several operations, stating by whom they have been executed, and their results, derived from the annual reports of the assistants and others employed, and prefacing these details by a notice of portions of the work in each section. In this part of the report I have felt at liberty to incorporate such statistics as are useful in the course of the survey in the office or field. Justice to the arduous labors of those who engage in the difficult operations of the work requires that they should receive a full acknowledgment of the service rendered. The progress of the out-door work is brought up to the first of October in all cases, and, when it is practicable, to the first of November; that of the office work to November.

The division of the coast into sections is as follows:

I. Passamaquoddy bay to Point Judith, including the coast of the States of Maine, New Hampshire, Massachusetts, and Rhode Island.

II. From Point Judith to Cape Henlopen, including the coast of Connecticut, New York, Pennsylvania, and part of Delaware.

III. From Cape Henlopen to Cape Henry, including the coast of Delaware, Maryland, and part of Virginia.

IV. From Cape Henry to Cape Fear, including the coast of the State of North Carolina.

V. From Cape Fear to the St. Mary's river, including the coast of the States of South Carolina and Georgia.

VI. From the St. Mary's river to St. Joseph's bay, coast of Florida, and including the Florida Reef and Keys.

VII. From St. Joseph's bay to Mobile bay.

VIII. From Mobile bay to Vermillion bay, including the coast of Alabama, Mississippi, and part of Louisiana.

IX. From Vermillion bay to the boundary, including the coast of part of Louisiana and of Texas.

X and XI. The coast of California and Oregon.

The triangulation is continuous, with one single interval of about fifty miles, which less than two seasons more will close, from the mouth of the Kennebec, in Maine, to Ocracoke inlet, in North Carolina, and is well advanced in South Carolina, Georgia, Florida, Louisiana, and Texas, and nearly completed in Alabama and Mississippi; and the other parts of the work are based upon this and keep pace with it. The survey of the western coast is making vigorous progress, striking first at the determinations most important to navigation. That the survey is not advanced more equally in the different sections, will be understood from the dates at which the appropriation has permitted the introduction of the operations on their full scale in them.

The work was in progress in all its main branches first in the different sections as follows: In No. I, in 1844; in No. III, in 1844; in No. IV, in 1847; in No. V, in 1849; in No. VI, in 1850; in No. VIII, in 1847; in No. IX, in 1850. No. II was nearly completed in 1844. In No. VI there is merely a reconnaissance, the appropriation not allowing the commencement of the other operations there. The operations on the western coast are necessarily, for the present, of a kind appropriate to the peculiar circumstances of the country.

The loss of the steamer Jefferson on the coast of Patagonia, on her voyage to the western coast, has seriously impeded the work which was laid out for the season in sections X and XI. The light-house surveys ordered by Congress on the western coast may be postponed for a brief time in consequence of this loss; but the arrangements made by the Treasury Department, to equip the steamer Corwin and to send her to that coast, will soon place the hydrography there on the footing designed for it. It will be recollected that the Corwin was constructed for the western coast; but that in order to save the working season of this, the Jefferson, considered in every respect suitable for the purpose, (see Appendix, No. 54,) was sent in her stead. The Jefferson should, in my opinion, be replaced, as she was one of the most useful steam vessels of the coast survey.

Before proceeding with an account of the progress of the coast survey during the past year, I would again respectfully call the attention of the department to the fact that no acknowledgment, of the kind

which is most grateful to a military man, has yet been made to Captain A. A. Humphreys, of the corps of topographical engineers, for his devoted and most valuable services to the work. His claims are of the strongest kind for zealous, able, and effective service, and I trust, sir, will be urged by you upon the President.

I proceed to state the general progress of the work during the past year as briefly as the nature of the operations will permit, referring for details to the next division of my report, in which each operation is treated under its appropriate head, and with reference to the persons by whom it has been executed. The progress of the work proposed for the next fiscal year is stated, in a general way, in connexion with the estimates.

Section I. *Coast of Maine, New Hampshire, Massachusetts, and Rhode Island.*—Nine parties have been employed in this section during the whole or part of the season; seven in land work and two in hydrography. Two of the topographical parties were double—that is, employed each two plane tables; and one of the hydrographic parties had three vessels, one of them a steam-vessel. The primary triangulation was extended to Cape Small Point, in Maine; and the astronomical and magnetic observations connected with it made at two stations. The reconnaissance was carried beyond the Penobscot. Special magnetic observations, for harbor charts, were made at three stations in Maine. The secondary triangulation was completed to Casco bay, and the reconnaissance carried over the bay. The topography of the vicinity of Chatham and Wellfleet, Massachusetts; of Cape Ann, from Beverly farms to the northeast point of the cape; and of Newburyport harbor, Massachusetts, was executed. The hydrography of the Nantucket shoals was continued. The hydrography of Muskeget channel was completed; off-shore soundings were made off Block island and Gay Head; the limits of soundings on Great Rip and Davis's bank extended; and the position of Fishing Rip determined. Tidal and current observations were made in Buzzard's bay and the Vineyard sound, and in the passages connecting them. Chatham harbor was examined; the hydrography of Salem, Newburyport, and Portsmouth (New Hampshire) harbors, and of their approaches, was completed. Tidal observations at Charlestown, Salem, and Newburyport, Massachusetts, and at Portsmouth, New Hampshire, have been made. Reports were made on light-houses, &c., at Naraguagus bay and the mouth of the Kennebec, Maine; in Boston harbor; off Chatham; in Holmes' Hole harbor, Massachusetts; and off Brenton's reef, Rhode Island. The difference of longitude of Bangor, Maine, and Cambridge observatory, Massachusetts, has been ascertained by telegraph, (November 25;) and Cambridge has been connected in the same way with a station of the British survey of Nova Scotia. A second chronometer expedition, for difference of longitude of Greenwich and Cambridge, has been in progress, and is nearly brought to a close.

The following maps and charts have been in progress, or published: Richmond's Island harbor, Maine; Salem harbor, Massachusetts, and its approaches; Nantucket shoals, new edition; and the general coast chart, Eastern series, No. 1.

Section II. *Coast of Connecticut, New York, New Jersey, Pennsylvania, and Delaware.*—The calls for work in this section, the most of which is essentially completed, have, as usual, been met by the employment of parties during a portion of the season when they could best be spared from other sections. The triangulation of the Hudson has been extended. Hydrography of verification has been made on the south side of Long Island, and at the entrance to the Connecticut river; additional off-shore work near the eastern end of Long Island has been done, and tides and currents have been observed for the off-shore chart. Sandy Hook has been re-surveyed to ascertain its changes; certain of the rocks and reefs in Hell Gate, near New York, have been minutely examined, to mark the changes by blasting; surveys of range lines for the main ship and Swash channels into New York harbor have been made. Tidal observations have been kept up at Governor's Island. Reports have been made on light-houses, beacons, buoys, &c., for Black Rock, Long Island sound, Gardiner's island, Sag Harbor, New York harbor, Fire island, Newark bay, and Passaic river.

The published charts and those in progress in this section are, Hart and City islands; south side of Long Island, eastern sheet; Hell Gate; off-shore chart, No. 1, from Gay Head to Cape Henlopen; mouth of Connecticut river; Long Island sound, western sheet; Sandy Hook sketch; Hell Gate rocks sketch. The atlas of Long Island sound requires but one harbor map to complete it, and that is well advanced.

Section III. In this section, which includes *the coast of part of Delaware, of Maryland, and part of Virginia*, ten parties have been at work. Astronomical observations have been made at two stations for latitude, azimuth, &c., completing the primary and astronomical work between the Washington observatory, Capitol, and the Chesapeake base. The primary triangulations have been extended down the Chesapeake, and preliminary determinations made to the capes. The secondary triangulation inside has advanced with the primary, and that outside has been carried to within about twenty miles of Cape Charles; next season these triangulations will be connected, verifying the secondary work, and the primary triangulation will be, probably, quite completed. The topography of both shores of the Chesapeake has advanced some forty-eight miles; the eastern shore to Rose Mary station, and the western to Wolf Trap. The topography on the outside has reached South Gargathy. The verification work of topography in the Patapsco and approaches, and on the eastern shore, has been continued. The hydrography has made excellent progress; the outside work has been extended twenty-six miles to South Gargathy, and the filling up inside, from Windmill point to Wolf Trap; the middle ground at the entrance to the Chesapeake has been sounded over. Tidal observations have been kept up at Old Point Comfort. Reports have been made on light-houses, &c., at Fishing battery (Chesapeake) and the Bodkin shoal (Patapsco.)

The map of Baltimore harbor and the Patapsco and the upper sheet of the Chesapeake have continued in the hands of the engraver. The drawings of the second sheet of the Chesapeake and of the outer coast have been commenced. The preliminary chart of the seacoast of Delaware, Maryland, and Virginia, has been extended southward so as to

give the Chincoteague shoals, employing the electrotype process to make the additions without loss of the original plate. A sketch of the middle ground at the entrance of the Chesapeake has been prepared and published.

SECTION IV. *Coast of part of Virginia and of North Carolina.*—Six parties have been employed in this section during part of the season—three land and three hydrographic parties, one of the latter having a steam-vessel. Observations for difference of longitude were made by telegraph and chronometers between Washington and Forbes' Point. A reconnaissance was made for the extension of the primary triangulation over Pamplico sound, which included also an examination of Core sound. The secondary triangulation of Currituck sound was extended northward, nearly to the Virginia and North Carolina line. The triangulation and topography of the entrance to Cape Fear river and of its approaches were executed. The tertiary triangulation of the ocean shore was carried from Cape Hatteras to Ocracoke inlet. The topography of Beaufort harbor and its approaches was completed. The hydrography of Albemarle, Roanoke and Croatan sounds was completed, and that of Currituck sound carried to the limits of the land work. Oregon inlet was examined. The Frying-pan shoals, off Cape Fear entrance, were surveyed. The hydrography of Cape Fear entrance and its approaches was executed. The exploration of the Gulf Stream, in this and the next section, was continued. Examinations, under the light-house law, were made at Beacon island, Ocracoke inlet, (November,) the Hatteras shoals, and Cape Fear river.

The first sheet of the map of Albemarle sound has been in progress, and the second sheet is begun. The preliminary chart of Beaufort harbor, and sketches of Cape Fear entrance and of the Frying-pan shoals, have been prepared and published.

SECTION V. *Coast of South Carolina and Georgia.*—The work has made very good progress in this section. Charleston and Savannah have been connected with each other, and with the Seaton station, Washington, for difference of longitude. Astronomical observations at Charleston have been continued. The opening of the lines of the primary triangulation was continued, and two stations have been occupied; the secondary triangulation of North Edisto river, the Dawho, St. Helena sound, South Edisto and Ashepoo rivers, has been made, and the reconnaissance extended on one side of the base to the Stono. A preliminary triangulation of Savannah river entrance has been made. The topography of the shores of North Edisto harbor and river, and of the shores of the Savannah river, near the city and at the entrance, has been executed. The hydrography of Charleston harbor, and that of North Edisto harbor of refuge, has been completed. Tidal observations have been made at Charleston and Savannah.

The map of Charleston harbor has made considerable progress, and a tracing on a large scale has been sent to the Chamber of Commerce of the city. Sketches of North Edisto harbor of refuge, and of Savannah entrance and harbor, have been prepared and published. The sketch of Bull's Bay harbor of refuge has been republished.

SECTION VI. *Coast of Florida, and keys and reefs.*—Five parties have [b]een employed during parts of the season on this coast. The base

lines have been prepared for final measurement; the reconnaissance has been extended. The triangulation has included Key Biscayne bay, the keys and sounds to Turkey key. The triangulation of Cedar keys and the vicinity of Crystal river has been commenced. The topography has embraced the Marquesas, Boca Grande and its vicinity, Bahia Honda, and Key Biscayne bay, and the main, to the limits of the triangulation. The hydrography of Key West and Boca Grande has been completed. A hydrographic reconnaissance has been made of Mosquito inlet, on the eastern coast of Florida, for placing buoys. Hourly tidal observations have been kept up at Key West.

The chart of Key West is in the hands of the engraver. Sketches of the reconnaissance of Cedar keys and Mosquito inlet have been prepared and published.

Section VIII. *Coast of Alabama, Mississippi, and Louisiana.*—The secondary triangulation has included work of revision, and has been extended westward, signals being placed in Lake Borgne and the Rigolets. Biloxi and St. Louis bays have been triangulated. The topography has advanced along Mississippi sound from West Pascagoula river, to include Biloxi bay, and has included part of Pass Christian. The hydrography has been extended outside east and west of Mobile entrance; has included Bon Secours bay, (Mobile bay,) Pass Christian, and a reconnaissance of the Southwest pass and the Pass à l'Outre of the mouths of the Mississippi. Hourly tidal observations have been made at Fort Morgan, Mobile entrance.

The chart of Mobile entrance has been published; the preliminary chart of Mobile bay has been prepared and published, and the drawing of the two sheets of the finished chart of the bay has been nearly completed. Sketches of Horn Island pass, Pass Christian, and the delta of the Mississippi, have been prepared and published.

Section IX. *Coast of Texas.*—The primary triangulation has been extended westward to the set of stations preceding the Brazos, and the secondary triangulation somewhat further. The topography of Galveston bay has been completed, including Turtle bay and the entrance of the San Jacinto and Trinity rivers, and East and West bays, to the limits of last year's triangulation. The hydrography of Galveston entrance has been completed, and that of the approaches nearly so. Hourly tidal observations have been made during part of the season at Galveston. The light-house sites in Galveston Upper and Lower bays, and at Aransas pass, have been examined and reported upon.

The drawing of the chart of Galveston entrance is in progress. Sketches of the bay and of Aransas pass, for light-house purposes, have been prepared and published.

Sections X and XI. *Coast of California and Oregon.*—The appropriation permitted merely the employment of the same force as last year; namely, four parties. Although the hydrography has been materially impeded by the untoward loss of the steamer Jefferson, already alluded to, the efforts made to keep the work moving onward have been attended with success. The geographical positions of Point Conception, Point Pinos (Monterey,) Point Loma (San Diego,) and Cape Hancock, or Disappointment, have been determined. Magnetic observations have been made at the same points. The triangulation of part

of San Francisco bay and of San Diego harbor has been made. Plane-table surveys for sites of light-houses have been made in San Francisco bay and its approaches, at Monterey, Point Conception, San Diego, and Cape Hancock, or Disappointment, and its vicinity, including Cape Adams. Surveys for the joint commission for naval and military defences have been made at Mare island, near Vallejo, and on both sides of the entrance to San Francisco bay. A full hydrographic reconnaissance has been made of Columbia river from its entrance to a point above Astoria, of Humboldt harbor and river, and of Trinidad bay; and a general hydrographic reconnaissance is in progress from Monterey to San Diego, as supplementary to that of last year from Columbia river to Monterey. Buoys have been sent to Columbia river by direction of the Treasury Department, to be placed by the coast survey party there. A report on a light-house site at Humboldt harbor is received, and one at Umqua river has been directed. Tidal observations are making near San Francisco.

The chart of Columbia river has been engraved, and will be published after making provision for the introduction of reported recent changes, if found to be of importance. Sketches of the reconnaissance of Humboldt harbor, Trinidad bay, San Francisco entrance and bay, San Diego harbor, Cape Disappointment, Point Conception, Point Pinos, and Point Loma, have been engraved and published. The work in the field is in vigorous activity, and the arrangements in the office for publishing are most thorough and effective.

Besides the work stated in the several sections, the computation of the field work, the registry and assemblage of it, the reduction of the land work and hydrography in the office, have kept pace with the out-of-door operations. Fifteen maps have been electrotyped. Sixty-three sketches, including those showing the progress of the work, have been prepared and engraved, to accompany this report.

The list of geographical positions from the preliminary computations of the survey, with the necessary maps to render it available to geographers, surveyors, and others, has been prepared with much labor, and is now appended to this report. (Appendix No. 12.)

In the estimates for the next fiscal year, I provide for the continuation of the work on the same scale which has been heretofore approved by the Executive and Congress; expressing, however, my conviction, which has been before stated, that the appropriations for the Florida reefs and keys should be increased, for at least a few years, to sixty thousand dollars, so as to enable the work to be rapidly pushed in that quarter.

The publication of the observations made in the survey, to which I have also, from time to time, called attention, is very desirable. It will secure them from all possibility of loss; can be done better, more quickly, more accurately, with greater knowledge of all details, while the work is in progress, than after it has all closed. The publication of the observations would tend to facilitate the progress of the work itself, and furnish means of estimating the relative value of different processes used in it. It has been warmly recommended by one of the first scientific bodies in the country, the American Philosophical Society. The cost of publishing the data from the work, and many results which

we are now cramped for means to give to the public, would not exceed thirty thousand dollars for the first year, and might be less afterwards. They should be published in a form suited to scientific observations, and creditable to the country, and under close supervision at the Coast Survey office.

I am satisfied that it will be best for a few years to give the full appropriation asked last year for the western coast, that we may render the facilities which the great and rapidly increasing commerce demands. The navigation by steam renders the necessity for a knowledge of the coast more than ever important, as steam-vessels run a direct course, keeping near the land, and stopping from harbor to harbor, as commerce requires. Until we have the necessary information of a general kind, we ought to press the survey in that quarter. The results, even under the disadvantageous circumstances of the past year, show what may be done by zeal and industry, furnished with adequate means. The addition of another party there is very desirable.

In making these estimates, I suppose the usual aid derived under the law from the War and Navy Departments. The unusual calls during the past year for payment of transportation of naval officers on first joining the work, ordered often, as they are, from distant points, and for clerks or draughtsmen for the hydrographic parties when ashore, have pressed heavily on our limited means, which did not hold out to the end of the fiscal year. I have provided against the recurrence of this contingency by addition to the estimates for the coast of the Atlantic and Gulf of Mexico, which, though small, is necessary to prevent the cutting off of part of the anticipated operations.

ESTIMATE FOR THE FISCAL YEAR 1852–'53.

General expenses for all the sections, namely: rent, fuel, postage; materials for drawing, engraving and printing; carpenter's work and materials; instrument maker's work and materials; blank-books, stationery, printing and ruling forms; binding; transportation of instruments, maps and charts, and miscellaneous office expenses; purchase of new instruments, books, maps, and charts.................... $16,000

SECTION I. Coast of *Maine*, *New Hampshire*, *Massachusetts*, and *Rhode Island*. *Field-work.*—To extend the primary triangulation in *Maine*, and make the reconnaissance and astronomical and magnetic observations connected with it; to extend the secondary triangulation over *Casco bay*, (Portland,) and to determine the heights of the stations between *Portsmouth (New Hampshire)* and *Portland;* to complete the topography of *Newburyport* harbor; to commence that of the coast between *Portsmouth* and *Portland*, and of *Portland* harbor; to complete the topography of *Cape Ann;* to continue the hydrography of the *Nantucket* shoals, and of the ocean near *Nantucket;* to commence that for off-shore chart No. 2; to complete that of *Chatham*, *Gloucester*, and *Annis Squam* harbors, and to commence those of *York*, *Saco*, and *Kennebunk;* to continue the observations of tides and currents in *Martha's Vineyard* and *Nantucket* sounds,

and to take the views required for the general coast chart No. 2. *Office-work.*—To make the reductions and computations for the section; to complete the drawing of coast chart No. 3, from *Cape Pogue* to *Chatham* light, the drawing of *Salem*, *Newburyport* and *Portsmouth* harbor charts, and to commence those of *Chatham*, *Gloucester*, *Annis Squam*, and *Portland* harbors; to continue the engraving of *Boston* harbor chart; to complete those of *Newburyport*, *Salem* and *Portsmouth*,—will require $36,000

Section II. Coast of *New Jersey*, *Pennsylvania* and *Delaware*. To continue the triangulation and hydrography of the *Hudson;* to make such work of verification as may be required; to complete the observations of tides and currents for offshore chart No. 1; to complete the engraving of south side of *Long Island*, middle sheet; to complete the engraving of *Connecticut* river entrance,—will require 7,000

Section III. Coast of *Delaware*, *Maryland*, and *Virginia*. *Field-work.*—To complete the triangulation of the shores of the *Chesapeake*, and of adjacent bays and roadsteads in *Virginia*, of the outer shore to the capes of *Virginia;* to make the astronomical and magnetic observations required, the secondary triangulation of part of the *Potomac* or of *James* river; to continue the topography of the shores of the Chesapeake to *York* river on the western shore, and *Tazewell's* on the eastern shore of *Virginia*, and of the outer shore of the peninsula to Rogue's island; to continue the hydrography of the outside to Rogue's island, and of the Chesapeake to *York* river, nearly. *Office-work.*—To make the computations for the section; to complete the drawing of a third sheet of the *Chesapeake* bay, and to commence the second series; to complete a sheet of the general coast chart of the outer coast; to complete the engraving of the first sheet of *Chesapeake* bay, and of a general chart of the upper section of the bay,—will require 33,000

Section IV. Coast of *North Carolina.*—To make the reconnaissance required in this and the next section; to continue the primary triangulation over *Pamplico* sound; the secondary triangulation northward, nearly to its connexion with that of the Chesapeake; to complete the tertiary triangulation of *Core* sound, and connect it with *Beaufort* harbor; to continue the triangulation of the *Cape Fear* river; to complete the topography of the ocean shore from *Hatteras* to *Ocracoke*, and of *Currituck* sound and the ocean shore northward, to beyond the Virginia and North Carolina line; to complete the hydrography of *Currituck* sound to the limits of the triangulation; to continue that of *Pamplico* sound and *Ocracoke* inlet; to continue that of the entire coast between *Cape Hatteras* and *Cape Fear;* to continue that of the *Cape Fear* river to *Wilmington*, (N. C.); to make the observations in the *Gulf Stream* in this section. *Office-work.*—To complete the drawing of the chart of *Albemarle*,

Croatan, *Roanoke*, and part of *Currituck* sounds; to continue the engraving of the first sheet; to draw and engrave the chart of *Cape Fear* entrance, of the *Fryingpan* shoals, &c.,—will require $25,000

SECTION V. *Coast of South Carolina and Georgia. Field work.*—To continue the secondary triangulation from its present limit eastward to *Charleston*, and westward from *Beaufort*, South Carolina; to complete the triangulation of the *Savannah* entrance and river, and of *Calibogue* sound; to continue the primary triangulation eastward to *Charleston;* to complete the topography of *Kiawah*, *James's* and *John's* islands, and of the shores of *Stono* and *Ashley* rivers; to complete the hydrography of *St. Helena* and *Calibogue* sounds, and to commence that of the ocean coast between Charleston harbor and Savannah entrance; to make the *Gulf Stream* exploration in this section; to make tidal observations at *Charleston* and *Savannah* entrance. *Office work.*—To make the computations required for the section; to complete the drawing of *Savannah* river, the engraving of the chart of *Charleston* harbor, and of *Savannah* harbor, entrance, and river, and of *North Edisto* harbor of refuge,—will require.. 23,000

SECTION VI. Reefs, keys and coast of *Florida*.—See estimate for special appropriation, as provided for the three years last past.

SECTION VIII. Coast of *Alabama*, *Mississippi*, and *Louisiana*.—To continue the main and secondary triangulation southward from the *Chandeleur* islands towards the mouths of the *Mississippi;* to complete the connexion of Washington, Mobile and New Orleans, for difference of longitude by telegraph; and to make a triangulation of the principal entrances of the Delta of the *Mississippi;* to continue the topography of the shores of *Pontchartrain* and of the *Chandeleur* islands and main; to continue the hydrography of *Mississippi* sound, and of *Louisiana* bay; to make tidal observations at several points on the coast of *Louisiana*. *Office work.*—To make the computations and reductions required by the field work of the section; to complete the drawings of the two eastern sheets of the map from *Mobile* entrance to the mouths of the *Mississippi;* the engraving of one sheet of *Mobile* bay, and the commencement of a second 25,000

SECTION IX. Coast of *Texas*.—To continue the main and secondary triangulation, to include part of *Espiritu Santo* bay; to continue the topography westward, to include *Matagorda* bay; to continue the hydrography of the outer coast and of the entrances, and *Matagorda* bay, and the tidal observations at points of the coast. *Office work.*—To complete the drawing of the map of *Galveston* upper and lower bays, and to commence the first sheet of the general coast chart of *Texas;* to complete the engraving of the chart of *Galveston* entrance, and to commence that of *Galveston*

bay; to make the computations and reductions required for the work of the section,—will require..................	$21,000
SECTIONS X and XI. Western coast, *California* and *Oregon.*—See estimate provided for, as last year, by special appropriation.	
Total, exclusive of Florida reefs and keys, and of the western coast..	186,000
SECTION VI. To continue the survey of the *Florida* coast, reef, and keys. *Field work.*—To complete the triangulation of the *Walker* keys; to continue that of the reef from *Key Rodriguez* southward and westward to *Key Vacas;* to continue the secondary triangulation of the western coast of *Florida* from *Crystal* river southward; to complete the topography of the keys to the limits of the triangulation; to continue the hydrography of the outer coast and reef, from *Ajax* reef southward. *Office work.*—To make the necessary computations and reductions; to complete the drawing of *Boca Grande* passage, and *Bahia Honda*, and the engraving of the chart of *Key West* harbor and the approaches; and sketches of the *Boca Grande* passage and *Bahia Honda*—will require	$30,000
SECTIONS X and XI. To continue the survey of the western coast, *Oregon* and *California*. *Field work.*—To determine the geographical positions, absolute and relative, of the most important capes and headlands in *California* and *Oregon;* to complete the triangulation of *San Francisco* and *San Pablo* bays, &c., and of *Santa Barbara* sound; to complete those of the several harbors already examined; to continue that of the *Columbia river*, and of *Puget's sound;* to complete the topography for the harbor charts already commenced, and for the sites of light-houses; to complete the hydrography of the *Columbia river;* to continue that of *San Francisco* bay, of *Monterey*, *Santa Barbara*, &c.; to complete the general examination of the harbors of the coast and to revise the general reconnaissance of the coast. *Office work.*—To make the computations and reductions; to complete the drawings and engravings for the sites of light-houses, and of the examinations of harbors; to continue those of *San Francisco* bay, *Monterey*, and the revised reconnaissance; to provide for the drawing and engraving of sketches received; for the engraving of the revised general coast reconnaissance; of the *Columbia* river survey; of *Santa Barbara* sound, &c.,—will require..............	150,000
The appropriation for the western coast will include the necessary repairs and expenses of a steam-vessel, and will add one party to those operating in that quarter.	
The appropriation for the coast of the Atlantic and Gulf of Mexico in 1850–51, was..............................	186,000
For the Florida reefs, keys, and coast......................	30,000
For the western coast, including the cost of a steam-vessel..	190,000

For the next year—the present fiscal year—the appropriations were severally $180,000, $30,000, and $100,000. I am satisfied, from experience, that the sums now asked are as small as, with the most economical administration of the survey, the work marked out can be executed for; requiring a close and constant care to make them give these results. The plan of operation is in a degree deranged, and the relative parts make a progress not adapted to each other, when the amounts are lessened; besides which, a portion of the work is necessarily cut off, and the survey makes slow progress. I am of opinion that true economy in such a work is to be found by enlarging the operations, thus increasing the division of labor. The work being of a temporary character, the enlargement of its expenditures is more than made up to the treasury by its less duration.

I proceed, next, to give a more particular account of the operations on the several sections of the coast, derived from the reports of the assistants and others employed; prefacing the more detailed statements with remarks on the progress of the section, and on the more interesting general results. The incidental notices of the office-work which thus occur in connexion with the sections, are followed by a complete detail of the progress in its various departments.

A table of occupation of the field and hydrographic parties is given in the Appendix, (No. 1,) showing their distribution during the different seasons appropriate to surveying different parts of the coast.

The light-house work executed in the different sections is stated in the general table, (Appendix, No. 15,) and more in detail under the head of each geographical section of the coast.

In the Appendix to this report, Nos. 13 to 14 *bis*, inclusive, will be found the instructions of the Treasury Department, and the general correspondence on the subject of light-houses, &c.; special reports being elsewhere given in the Appendix, in connexion with the section to which they refer. The Appendix No. 16 contains a circular to the chiefs of hydrographic parties, referring to a communication from the secretary of the Light-house Board, asking suggestions for the improvement and extension of the present light-house establishment, and extracts from the replies.

Section I.—from Passamaquoddy bay to Point Judith, including the coast of Maine, New Hampshire, Massachusetts, and Rhode Island.—(Sketch A.)

The new appropriation having been available from the very beginning of the fiscal year, the work in this section has made very good progress. Two triangulation, three topographical, and two hydrographic parties, were at work during nearly the whole of the season; one of the triangulation parties making also the astronomical and magnetic observations connected with the primary work; two of the topographical parties using each two plane tables; and one of the hydrographic parties having, for the greater part of the time, three vessels—one of them a steam-vessel. The primary triangulation was extended to Cape Small Point, at the mouth of the Kennebec, and the reconnaissance for it beyond the Penobscot. The secondary triangulation was

completed to Portland. The topography of Cape Cod, Cape Ann, and Newburyport harbor, in Massachusetts, was nearly completed. The hydrography of Nantucket shoals was continued; that of Salem, Chatham, Portsmouth, and Newburyport harbors completed; off-shore work off Block island and Gay Head was executed; and tides and currents were observed near the Elizabeth islands, in the Vineyard sound and Buzzard's bay, at Holmes' Hole, Salem, Newburyport, and Portsmouth. The permanent tidal station at Charlestown, Massachusetts, has been kept up, and observations for several lunations have been made in Salem, Portsmouth, and Newburyport harbors. The office-work has made corresponding progress.

Accompanying this report (sketch A, No. 3) is a current chart, showing the nature and results of observations of previous years in the harbor of Boston.

The preliminary chart of Richmond's Island harbor, issued to meet the wants of the Committee on Commerce, has given place to a more complete map.

During the great gale of April last, the violence of which was especially felt on the coast of Massachusetts, an opening was made through Chatham beach, (see sketch A,) giving a more direct and deeper entrance to the harbor of Chatham than had previously, at least of late years, existed. This attracted much attention, and hopes were entertained that a harbor of refuge might thus be obtained at a point where one was much needed. I incorporated in the instructions of the season directions to examine Chatham harbor, and if the bar and entrance were found in a moderately permanent condition, to make a complete survey of it. The topographical party of Assistant J. B. Glück was instructed to complete, without delay, the shore line; and Lieutenant Commanding Woodhull to take some convenient opportunity, towards the close of his operations in the Vineyard sound, to make the desired examination. This was promptly executed. The greatest depth which he found could be carried over the bars, at *high* water, was eleven feet; the rise and fall of the tide being about four and a half feet. There is deep water—in one spot twenty-two feet at low water—near the village of Chatham. The changes from week to week in the *outer bar*, he was satisfied, were such that a chart could not be made which would be of service to navigation. He accordingly recommended the postponement of the survey until a more permanent condition was reached; making, meanwhile, quite a careful examination, which has been plotted, and the chart representing which has been placed on file in the office, where it may be consulted by, or copied for, those who are especially interested in the matter.

The occupation of some twelve more stations will complete the primary triangulation to the northeastern boundary. The reasons which render it more expedient to employ a party only during part of the season for this purpose, have been frequently stated. The primary triangulation is still in advance of the secondary, though, in consequence of the desirableness of prompt surveys of some of the harbors in the more eastern part of the section, that operation has been pushed well forward.

The difficult and comparatively expensive hydrography of the Nan-

tucket shoals, has delayed the hydrography beyond my calculations. The transfer of one of the southern hydrographic parties to this section formed part of my plan for the past season, which was interrupted by causes beyond my control, and which it is not necessary here to state. The plan is only deferred, not given up. The examination for a base of verification will be made next season, or in the following one; and, should a suitable one be found, the triangulation will be directed in reference to a junction with it.

The tides, and currents resulting from them, in the passages between the Elizabeth islands are altogether peculiar, and require close investigation. On one side of the islands the rise and fall belongs to Buzzard's bay; and on the other side to the Vineyard sound. The Buzzard's bay tide is propagated through the entrance between Cuttyhunk and Saghkonnet Point. (See sketch A.) The two chief passages used by vessels between the Vineyard sound and Buzzard's bay are Wood's Hole and Quicks' Hole. The plan which I sketched for determining the facts in regard to the tides was the establishment of three tide-gauges, to be observed during the same period on the north side of the Elizabeth islands at Wood's Hole, Kettle cove, and Quicks' Hole; and on the south side at Wood's Hole, Tarpaulin cove, and Quicks' Hole. These observations would give the corresponding phenomena and their progress between the two passages, and, being completed satisfactorily, the gauges from Kettle and Tarpaulin coves were to be removed to points nearly midway, or, better, at or near the point of meeting of the tides from the bay and sound, between the two gauges in Wood's and the two in Quicks' Hole, so as to determine the relation of the movement in these passages. This plan has been satisfactorily carried out during the present season, except that three days of simultaneous hourly observations, which I considered essential to its completeness, could not be made on account of the boisterous character of the weather.

During the season I had repeated conferences with the chiefs of parties in this section when the diversified operations required it, but made no special inspection. The inspection of a portion of the operations was made by Major I. I. Stevens, of the corps of engineers, assistant in charge of the office.

In 1849, a special expedition for the determination of the difference of longitude between the coast survey stations and European observatories was organized and reported upon. During the following year the reduction of the observations was made, so as to draw upon the experience of that operation for improvement in a subsequent one. During the past season the second trial has been made, the general results of which will be stated in their place from the report of Professor W. C. Bond, director of the Cambridge observatory, by whom, in concert with Mr. Hartnup, director of the Liverpool observatory, the work has been executed.

Arrangements have also been made, through Professor Bond, for connecting the coast survey of the United States with the surveys making by the British government in Nova Scotia. The occasion will be taken to obtain the longitude, by telegraph, of Bangor, in Maine, an important point in every respect, while facilitating the connexion of Cambridge and Halifax. The thanks of the Survey are due to H. O. Alden, esq.,

the president of the Maine Telegraph Company, for assistance rendered in these operations. (See Appendix, No. 18.)

The appropriations for light-houses, beacons, buoys, &c., embraced in the bill approved March 3, 1851, for localities within this section, were the following:

"*Maine.*—1. For buoys on White's and Thom's ledges, and on Pond Island reef, at the mouth of the Kennebec river, three hundred dollars.

"2. For a light-house on Pond island, at the entrance of Narraguagus bay, four thousand dollars.

"*Massachusetts.*—3. For a light-boat on the Shovelful shoals, off Chatham, twelve thousand five hundred dollars.

"4. For eleven buoys in the channel to Commercial point and Neponset river, in Dorchester, one thousand dollars.

"5. For a light-house at the head of Holmes' Hole harbor, three thousand five hundred dollars.

"6. For a beacon on Fawn bar, near Deer island, Boston harbor, two thousand five hundred dollars.

"7. For two iron spindles on the northeast ledge of the Graves, and on Harding's ledge, Boston harbor, two thousand dollars.

"*Rhode Island.*—8. For a light-boat off Brenton's reef, fifteen thousand dollars."

Examinations of all these were required, under the law, by the Fifth Auditor, and were made, according to the instructions from the Treasury Department, under my direction. My reports will be found in the Appendix, (Nos. 19, 20, 21, and 22,) accompanied by those of the assistants of the survey to whom the examinations were referred, (Lieutenants Commanding Charles H. McBlair and Maxwell Woodhull, United States navy,) which contain all the details necessary to an understanding of the subject. In every case a thorough examination of the localities was made, wherever the coast survey extended, by the aid of its charts, and the reports state fully the requirements of navigation in reference to the objects embraced in the bill.

The buoys at the mouth of the Kennebec (No. 1) were recommended to be immediately placed, (July 28.) The light-house on Pond island, Narraguagus bay, (No. 2,) was also recommended to be erected, to contain a revolving light. A light-boat on the southeast extremity of Shovelful shoals, off Chatham, (No. 3;) a beacon on Fawn bar, near Deer island, (No. 6;) and two iron spindles on the Graves and Harding's ledges, Boston harbor, (No. 7,) and the light-boat off Brenton's reef, (No. 8)—were recommended to be placed. The buoys in the Neponset river (No. 4) had already been reported upon favorably from the office of the Coast Survey. Instead of the light-house at the head of Holmes' Hole, three small beacon-lights, (technically called "bug-lights,") for ranges, were recommended, and their positions indicated on a chart. It was supposed that the three beacon-lights could be put up for the amount of the appropriation for a single light-house.

A fog-whistle for the light-house on Petit Menan island, instead of the present fog-bell, and a buoy on Thomas' reef, near Thom's reef, at the entrance of the Kennebec—objects for which an appropriation had been made—were reported as desirable.

The reports of the examining officers not only show that there are

good reasons for establishing the facilities to navigation provided in the act of Congress for this section of the coast, but give collateral information and facts of very considerable interest, adding much to our knowledge of the coast.

In a communication, in reply to questions from the Light-house Board, Lieutenant Commanding McBlair presents the following subjects for consideration: 1. The substitution of a light-house on the ledge called Sow-and-Pigs, off Cuttyhunk, at the entrance to Buzzard's bay, for the light-boat now placed there, and the light-house now existing on the island of Cuttyhunk; (see sketch A.) 2. The placing of a floating beacon on Davis' New South shoal; (see sketch A, No. 2.) This shoal lies near one of the most frequented parts of the ocean, and has occasioned some very disastrous wrecks. It has as little as eight feet water upon it, is swept by very strong tidal currents, and, during the summer months, is almost constantly hidden by fogs. It was designed at one time to erect a beacon upon it; but the great difficulties of the undertaking, arising from the character of the climate and the distance of the nearest port, seem to be regarded as insuperable. It is, however, indispensable to the safety of passing vessels that it should be marked in as distinct a manner as circumstances will admit. 3. A buoy-boat on the Great Rip, one of the most extensive of the Nantucket shoals. 4. A buoy-boat on the sand shoal lying to the eastward of the northern end of Bass Rip. 5. A spar-buoy on the sand-spit extending from Fox's Point, Nashawena island, at the southern entrance of Quicks' Hole; (see sketch A.) 6. A wooden beacon, (to be painted black,) on Long island, Boston harbor, placed so as to range with the northeast end of Spectacle island, for the safe navigation of the main ship channel; (see sketch A;) recommended also by Lieutenant Commanding Charles H. Davis, in 1847. 7. A similar beacon on the southeast part of Long island, Boston harbor, to range with Nix's Mate, and to facilitate the passage through the Broad Sound channel. 8. A buoy-boat on the southwest end of Billingsgate shoal, Manchester bay, and two spar-buoys on the southern edge of the shoal, planted at regular intervals between the boat and Billingsgate island. 9. A spar-buoy on Bibb Rock, southward and westward of Wellfleet harbor. 10. Changes in the position of the lights at Chatham, to adapt them to the changes in the coast there.

These recommendations are fully concurred in, as his field of work has extended, by Lieutenant Commanding Swartwout, who commanded the brig Washington, attached to Lieutenant Commanding McBlair's party.

In connexion with this subject I present the following extract from a report (November, 1850) of Lieutenant Commanding Maffitt, United States navy, assistant in the coast survey:

"I examined a rock in the main ship channel, Boston harbor, near the buoy of the Lower Middle, upon which the British mail steamship Cambria struck, and found it to be identical with a rock already found on the Coast Survey chart to be seen in the work of 1847."

Reconnaissance.—It has been necessary merely to extend the reconnaissance in this section, during the present season, to one range of stations beyond the Penobscot, in order to prevent possible interference with the primary triangulation of the next season. This has been done

by assistant C. O. Boutelle, and the result is shown on sketch A. The fact that, if necessary to the work, either from the position of the final base of verification in this section or other cause, a point can be found on the Ebeeme mountains readily connected with the coast, has been ascertained. Mr. Boutelle also established the station on Ragged mountain, (Camden mountains.) He was accompanied during his reconnaissance by Major Prince, United States army, assistant in the coast survey.

Mr. Boutelle made, also, a reconnaissance for the main chain of secondary triangles over Casco bay in the course of the season.

Primary triangulation, astronomical observations, &c.—The party under my immediate charge was transferred to this section in July, and between the second of that month and the fifth of November two stations were occupied for geodetic and astronomical work, and one for astronomical observations. The magnetic variation, dip, and intensity, were measured at two of the stations; vertical angles were measured for height at the three; and a meteorological register was kept during the progress of the other observations. The area of the work, estimated in the usual way, was 2,402 square miles. I was assisted in the measurement of horizontal and vertical angles, and the azimuth determinations, by Lieutenant W. P. Trowbridge, of the corps of engineers, and the observations for time and latitude were made under my immediate direction by sub-assistant George W. Dean.

At Mount Pleasant station, (Oxford county, Maine,) 22 horizontal angles of the primary triangulation were measured by 1,300 observations, with the thirty-inch theodolite of Troughton and Simms, (C. S. No. 1,) 130 vertical angles for difference of height, with the micrometer of this instrument, and thirty for absolute elevation, by a six-inch Gambey theodolite, (C. S. No. 34,) sets of six repetitions being employed. A signal was placed upon the highest point of Mount Washington, and observed upon whenever the atmosphere was clear.

The azimuths were measured by seventy-two observations, in seven sets, on Polaris, near the upper and lower culmination, the method, referred to in my report of last year, of corresponding azimuths before and after culmination being used. The star was referred to a mark distant about three-quarters of a mile, nearly in a line to the Blue Mountain station, between which and the mark the angle was measured by the micrometer. The observations were made with the thirty-inch theodolite, (C. S. No. 1,) and in five positions of the instrument.

The latitude was determined by Talcott's method, with a zenith telescope by Würdeman, (C. S. No. 5,) which has been already referred to, having a focal length of forty-nine inches, an aperture of three and a half inches, and used with a magnifying power of six hundred. Two hundred and thirty-six observations were made upon forty-four pairs of stars, arranged from eighty-one stars taken from the Greenwich catalogue; using, also, as many as practicable of the stars of which the places have been determined by the Coast Survey zenith sector. The usual determination of the value of the micrometer and level divisions of the instrument were made. The longest and shortest sides of the primary triangulation of the season were eighty-four and twenty-two miles, respectively.

Some of the lines from Mount Pleasant having been obstructed by the erection of a new house upon the mountain, a second station point was selected by Mr. Boutelle, about fifty-seven feet from the first, and in the line from Sebattis to the original station. This distance was very carefully measured twice by a standard metre-bar placed on a wooden frame, the two measurements scarcely differing. They were made by myself, assisted by Lieutenant Trowbridge and Mr. Dean.

I was indebted for assistance, in posting heliotropers and other arrangements, to assistant C. O. Boutelle and Mr. Fairfield. Mr. Boutelle also observed for me during a brief absence, on duty, from Mount Pleasant.

At Ossipee station, (York county, Maine,) 15 horizontal angles were measured by 1,470 observations, with theodolite No. 1, and 128 vertical angles for height, with its micrometer, and with the six-inch Gambey theodolite, before referred to.

At Cape Small station, (Lincoln county, Maine,) eleven observations for azimuth were made on seven different days. The observations were made on Polaris—six at upper culmination, four at eastern elongation, and one at western elongation.

The observations for time and latitude, made under my direction by sub-assistant Geo. W. Dean, were as follows:

At Mount Pleasant station, 94 observations for time, upon 16 stars, paired as high and low stars, with transit C. S. No. 6, (Troughton and Simms,)—the equatorial intervals of the wires of this instrument were determined by 47 observations upon six stars. For latitude, 236 observations were made with zenith telescope C. S. No. 5, (Würdeman,) upon 44 sets of stars arranged from 81 different stars selected from the Greenwich twelve-year catalogue. When the places of the stars have been determined with the zenith sector as well as at Greenwich, equal weight has been given to each determination. For the value of the micrometer, 50 observations were made upon Polaris at eastern elongation, and 79 observations upon a collimator for value of level scale.

At Cape Small station, with the same instruments, 104 observations for time were made upon 14 stars, and 243 observations for latitude upon 40 sets arranged from 79 different stars. For the value of the micrometer of the zenith telescope, 91 observations were made upon Polaris at eastern elongation; for value of level of same instrument, 48 observations upon a collimator, in the usual manner.

The time of beginning and end of the solar eclipse of July 27, 1851, were observed at Mount Pleasant station.

The magnetic observations made by sub-assistant Dean, assisted by Mr. Edward Goodfellow, at Mount Pleasant and Cape Small, were as follows: For declination, 132 observations on 9 different days; for horizontal intensity, 7 sets on 7 days; and for dip, 5 sets on 5 days. The declination and intensity were observed with the portable declinometer of Gauss & Weber, as arranged by Professor Lloyd and Colonel Sabine, (Jones, No. 22, C. S. No. 1,) and the dip with a circle of eight inches, belonging to the Smithsonian Institution.

The meteorological observations at these stations, made by Mr. Edward Goodfellow and Mr. B. F. West, consisted of 328 readings for

temperature of the air, for moisture, (wet bulb thermometer,) for pressure, (Alexander barometer,) and miscellaneous.

Additional observations were made eight times a day, on eight days, of the barometer, thermometer, &c., by request of Professor Arnold Guyot, of Cambridge, to correspond with his observations for height in the White mountains and the adjacent country. The height of the surface plane, as shown by clouds resting on the Presidents' range, was also noted from Mount Pleasant at his suggestion. These observations were made by Mr. Edward Goodfellow and Mr. B. F. West.

The following magnetic observations were made by assistant J. E. Hilgard, between the 15th and 31st of August. The localities indicate the charts to which the results of the variation will be applied.

Stations.	Declination.	Dip.	Intensity.
Bramhall's Hill, in Portland	3 days	4 sets	2 sets.
Kennebunk Port	3 "	3 "	2 "
Cape Neddock	3 "	3 "	2 "

These observations complete the series as far east as Portland harbor.

The instruments used were the declinometer No. 20, by Jones, and a nine-inch dip-circle by Barrow, with reading microscopes and verniers.

Assistant S. C. Walker has collected, for convenient reference and comparison, all the results obtained by the transportation of chronometers for the differences of longitude of Harvard and Liverpool observatories. The data are those reported by William Cranch Bond, esq., director of the Harvard observatory, for the Coast Survey, and those of the special chronometer expedition of 1849–50, undertaken by the Coast Survey, and under Mr. Bond's immediate direction. They are classified as follows:

1. Results by chronometers making one *western* voyage, between Boston and Liverpool, and on trial for the government, or for the commercial marine.

2. Results by chronometers used in several western voyages prior to 1849.

3. Results of the western voyages in the special chronometer expedition of 1849–50 (also reported by Professor Bond) with ordinary chronometers.

4. As class 3, but with selected chronometers.

5. Results of eastern voyages, otherwise as class 3.

6. As class 5, but with selected chronometers.

The indiscriminate mean of the results by these six classes gives for the longitude of Cambridge, west of Liverpool, 4 hours 44 minutes 39.96 seconds.

The services of W. C. Bond, esq., director of the Cambridge observatory, have been rendered to the Coast Survey in various astronomical observations, telegraphic and chronometer operations, the nature and progress of which may be gathered from the following extracts from his report:

"I have to report the observation of thirty moon culminations, a portion of which have been forwarded to the Coast Survey office at Washington, corresponding to similar observations made at Point Pinos and San Diego, California, by Coast Survey assistant Davidson.

"Twelve occultations of stars by the moon and one solar eclipse have been observed at this place, the latter by four observers, each being furnished with separate chronometers and instruments. The telescopes used were of different kinds and powers, according to the suggestion of Mr. Airy, in his paper of instructions relative to this eclipse.

"The results which have been obtained by means of the electro-magnetic apparatus for recording astronomical observations are quite satisfactory. This method of adapting the electric current to the wants of the astronomer, and which has grown up under the fostering care of the Coast Survey, is purely *American*, and is acknowledged as such in Europe.

"The complete apparatus designed and made by ourselves for the coast survey, after having been tested at this observatory during several months, was, with your consent, taken to England, and put in operation, in May last, at the Royal Astronomical Society's rooms in Somerset House, in London, where it was examined and tried by those who felt an interest in such matters, this being considered the most effectual course to pursue in order to convince astronomers of the superior accuracy, expedition, and convenience of this method. At the request of several distinguished scientific gentlemen, the coast survey apparatus was transferred to the rooms of the British Scientific Association, at Ipswich; and, subsequently, we were urged to have it put up in the department assigned to American inventions at the great Exhibition in Hyde Park. As a proof of the estimation in which this is held, I may be allowed to mention that the Astronomer Royal is now engaged in introducing the 'American' method of recording into the observatory at Greenwich; and we hear, through the newspapers, that the council-medal of the great Exhibition has been awarded to our apparatus: it had previously obtained the gold medal of the Massachusetts Mechanical Association. We have nearly completed a similar apparatus for our own use at this observatory, in order more particularly to observe moon culminations, in connexion with your apparatus, when it shall have been put in operation at the Seaton station, in Washington.

"The chronometer expedition, which you put under my care, for determining the differences of longitude of the observatories of Greenwich, Liverpool, and Cambridge, closed for the season—so far as the transfer of chronometers was concerned—on the arrival of the steamer America, on the 17th instant. We have, this year, the data given for differences of longitude by one hundred and ninety chronometers; these instruments are now on trial for their subsequent rates, and will be subjected, for temperature corrections, to the cold of the approaching winter.

"According to your instructions, I have made preliminary arrangements for the connexion in longitude, by means of the electric telegraph, of the British surveys of the Bay of Fundy and Gulf of St. Lawrence with the United States coast survey. Commander Shortland writes me that he will be in readiness to meet us at Halifax the beginning of November."

In this section, Wm. Mitchell, esq., has also been engaged in astronomical observations for the use of the coast survey. His results for

the year consist of 200 pairs of zenith distances of stars, 37 moon culminating observations, 2 occultations, and 50 meridian transits for time.

Secondary triangulation.—The scheme of secondary triangulation of the coast of New Hampshire and part of Maine, between the Piscataqua and Saco rivers, commenced last year by Captain T. J. Cram, United States topographical engineers, assistant in the coast survey, has been completed this season to the line Ossipee—Fletcher's neck, (see sketch A,) including its complete connexion with the primary work. The party took the field on the 20th of June, between which date and the 7th of October, to which Captain Cram's report extends, 20 stations were occupied, and 952 sets of observations made on 199 points, consisting of stations, light-houses, steeples, &c, with the twelve-inch repeating theodolite of Troughton & Simms, (C. S. No. 18.) Of these stations occupied, eight were in New Hampshire and twelve in Maine. Not less than six repetitions with the telescope direct, and six telescope reversed, were counted as a set; the total number of observations being 8,148. The area covered by the secondary triangulation proper, and including the triangles which connect it with the primary work, is 700 square miles.

At the station marked "Mason" on the sketch, the instrument was elevated fifty-two feet above the ground, to avoid expensive cutting of the woods around it. Captain Cram reports the results of this experiment to be satisfactory.

This work is connected with the secondary triangulation of the coast of Massachusetts, by assistant C. O. Boutelle, on the southwest, at the line "Powow—Seabrook;" with the secondary triangulation laid out for Casco bay, by the same assistant, on the line "Fletcher's neck—Ossipee:" it unites with the triangulation of Portsmouth harbor, by Captain Stansbury, United States topographical engineers, on the line "Newcastle—Pulpit rock," and is controlled by the connexion with the primary stations "Pattuccawa," "Agamenticus," and "Ossipee," and the stations "Isle of shoals" and "Fletcher's neck," observed upon in the primary series. In all the connexions referred to, the importance of which is ably set forth in Captain Cram's report, there are lines of verification.

Captain Cram was engaged during the winter in copying in duplicate and in computing his work of the past season, as far as the data were complete; the entire office work was not, however, finished, before it was necessary to take the field; so that with the completion of the scheme of triangulation of this part of the coast this year, there is a considerable accumulation of office-work.

After the date of my report of last year, assistant C. O. Boutelle completed his work connecting the secondary triangulation of the coast of Massachusetts with that of New Hampshire and Maine, erecting the necessary signals and measuring the angles, between the 1st of October and 8th of November. The number of stations occupied was 12, and 156 angles were measured, upon 154 objects, by 950 observations. Vertical angles were also measured upon 38 objects, 59 zenith distances being determined by 578 observations. The instrument used in both cases was an eight-inch theodolite by Gambey, (C. S. No. 21.) In

reference to the method of determining heights by observing zenith distances, Mr. Boutelle remarks:

"The height above the mean level of the sea of the point of observation, in the tower of the Harris street church, (Newburyport,) has been carefully determined. The plane of mean level of the sea was obtained by observations on seven consecutive tides in the Merrimack river, at one of the Newburyport wharves. These were referred to a bench-mark on the top of the wharf, from whence a series of levels was carried to the church. It is pleasant to be able to state that the height of 'Powow hill,' determined from these observations, differed less than a foot from that obtained by a series of zenith distances, running through many sides of triangles, from levels taken at Dorchester Heights and Nantasket, in Boston harbor."

Mr. Boutelle was assisted by Messrs. Fairfield and Gregorie. After closing this work, he proceeded to the office to prepare for the duty assigned him in Section V, of which an account is given in its proper place.

Topography.—The topography has employed two double parties and one single party during the chief part of the season: one of the former working on Cape Cod, the other on Cape Ann, and the latter near Newburyport. The plane-table sheets are shown on sketch A, and are numbered 28, 31½, 37, 38, 39, and 41. The area embraced in them is 66 square miles, and the extent of shore-line 217 miles.

The weather, which has been generally unfavorable for the operations of the survey, has been very favorable to the execution of the topography. The nature of the ground in this section makes it, however, the most difficult to represent, from its varied surface, and from the number of details required in many places by the closely settled character of the country.

A double party (that is, a party working two plane tables) under the charge of assistant H. L. Whiting, with Mr. R. M. Bache as assistant, has been occupied from the latter part of June until early in October, in continuing the topographical survey of Cape Ann. The work is comprised in three sheets, Nos. 37, 38, and 39, (sketch A,) and extends from Beverly farms, near Salem, along the south shore of the cape to its extremity; and on the eastern shore to Halibut Point, the northeastern point of the cape. The area embraced is 35 square miles, the extent of shore-line 60 miles, and the extent of coast measured, in its general direction, about 18 miles. The topography includes Manchester and Gloucester harbors, and Rockport, and extends from the shore to the nearest road in the interior, thus including nearly all the area between the water-line and the rocky and wooded portion of Cape Ann, until near the eastern portion, when it embraces the highest ground of the cape. The difficult character of this survey will be understood from Mr. Whiting's general description of the topography of the cape: "The character of the country is broken and rocky. The range of hills forming the back-bone, as it were, of the cape, is covered with a mixed growth of pine, oak, maple, &c., and is generally unsusceptible of cultivation; the land is sterile, and among the valleys and broken ridges are numerous swamps. The average height of the hills

and ridges is from 150 to 200 feet, with occasional peaks of 225 and 230 feet.

"The extremity of Cape Ann, including the townships of Gloucester and Rockport, is nearly an island, formed by the inlet of Gloucester harbor and river from the south, and Annis Squam harbor and river from the north. These waters nearly unite; and formerly a canal was opened, making a communication between them; but the tide meeting from the two entrances and the shoal waters of Squam river made it of little service; and now the main road to the peninsula is diked across the canal, entirely closing it.

"The interior of the peninsula is lightly wooded among the hills and swamps, but generally barren of foliage. The land first seen from sea is 'Poole's hill,' about 230 feet high. Pigeon hill is about 195 feet; but being quite near the shore, is soon made from sea. Rail-cut hill is about 210 feet, and near Gloucester harbor.

"The character of the shore and waters of Cape Ann is more bold and broken than any thus far surveyed in this section."

The shores of the extremity of Cape Ann are bold and abrupt. "Coasting vessels, in rounding the cape, pass quite near the shore; and the harbor of Gloucester is quite deep in comparison with similar waters to the westward.

"There are some dangerous ledges and rocks off the eastern point of the cape, the 'Salvages,' the 'Londoner,' &c.; but the lights of Thatcher's island are sufficient guides to navigators in avoiding them, and I believe but few wrecks or disasters occur to vessels in passing the cape.

"The character of the topography has been of the most complicated and intricate kind, the details in contour, outline of shore, &c., being the greatest yet surveyed in this section. The artificial details in the towns of Manchester, Gloucester, and Rockport, are also very great."

The work in Beaufort harbor, North Carolina, by Mr. Whiting, is described under the head of Section IV; he is now under instructions to proceed to Savannah river, (Section V.)

A double party, under charge of assistant J. B. Glück, with Mr. W. S. Walker as aid, was at work on Cape Cod from the latter part of July to the close of October; at first on the sheet No. 28, in the vicinity of Chatham, and next on No. 31½, near Wellfleet. Up to the first of October, the area surveyed was eleven and five-eighths square miles, and the extent of shore-line 72 miles. In his report, Mr. Glück remarks: "In illustration of the intricate nature of topography upon sheet No. 28, Cape Cod, I would state here, that an area of only 7¼ square miles contains not less than 162 hill-tops, 143 hollows, and 21 ponds of larger and smaller size, with hills from 10 to 100 feet high, the representation of which forms a most complicated system of horizontal curves; a circumstance which should explain satisfactorily the comparatively small amount of area surveyed upon Cape Cod." The shore-line of Chatham harbor was furnished to the hydrographic party who made the examination there.

On the Wellfleet sheet, (No. 31½,) Mr. Glück surveyed 5½ square miles, and determined 18 miles of shore-line, closing his work in this

section, and transferring his party to the Patapsco (Section III) at the close of October.

The surveying done by Mr. Glück in Sections II (for light-houses in New York harbor) and III (Patapsco river,) will be found noticed in its appropriate place.

Assistant A. W. Longfellow commenced the execution of the topography of Newburyport harbor on the 15th of August, and will discharge his party about the 20th of November. Up to the 1st of November he has surveyed an area of 13½ square miles, and an extent of shore-line of 67 miles. The work was begun on Plumb island, and included, first, the immediate shore-line of the harbor and approaches, which were furnished at once to the sounding party, for use in their operations. It includes the wharves and principal streets of the city, and will comprise, this season, all that is necessary for a harbor map. The plane-table sheet of this work is numbered 41 on the sketch A.

Hydrography.—The party under the command of Lieutenant Charles H. McBlair, United States navy, assistant in the coast survey, commenced work about the close of June, and finished about the middle of October. (See sketch A, Nos. 1 and 2.) The continuation of the hydrography of Nantucket shoals formed the first object of the season; next, the completion of the work in Muskeget channel, for the chart of that passage, which is nearly prepared for publication; next, some supplementary work between Martha's Vineyard and Block island, for the off-shore chart, which is also nearly engraved; and last, the completion of the hydrography of Salem harbor. The progress made, to September 25, is stated by Lieutenant Commanding McBlair in his annual report, as follows:

"The hydrography of the shoals was prosecuted between the 3d July and 8th September; that of the Muskeget channel, between the 9th and 13th of September; and the remaining period, between the last date and the present time, has been occupied in the filling-in work to the westward of Martha's Vineyard.

"The results obtained in the different sections are exhibited in the annexed tables. (See sketch A, Nos. 1 and 2.)

1. *Field of work.—Nantucket Shoals.*

Area included within sounding limits	130 square miles.
Extent of sounding lines	252 miles.
Number of casts of lead	2,622
Depth of water	varying from 13 feet to 23 fathoms.

2. *Field of work.—Muskeget channel and approaches.*

Area within sounding limits	43 square miles.
Extent of sounding lines	103 miles.
Number of casts of lead	2,956
Depth of water	varying from 6 feet to 21 fathoms.

3. Field of work.—Between Block Island and Gay Head.

Area within sounding limits	105 square miles.
Extent of sounding lines	146 miles.
Number of casts of lead	1,000
General depth of water	18 fathoms.

"The hydrography of the Nantucket shoals (sketch A, No. 2) embraced the completion of the survey of the shoal to the north and west of Davis's bank, the re-examination and continuance of the survey of Davis's bank, and the determination of a part of Fishing Rip.

"The shoal north of Davis's bank is only separated from the Great Rip by a narrow slue, and may be regarded as merely the southern extremity of that shoal.

"Davis's bank is found to extend upwards of seven miles to the southward of its supposed limits in that direction, but our opportunities did not enable us to reach and determine its extreme southern point. The Fishing Rip is only generally established as to position.

"To determine its outline, extent, shoalest water, and general characteristics, will require a more extended and minute examination than it was in our power to bestow on it during the season.

"The past summer has been marked by an extraordinary prevalence of fogs and gales, which have seriously interrupted our operations, and limited the results."

On closing this part of the work Lieutenant Commanding McBlair, in the steamer Bibb, proceeded to Wellfleet to examine changes which were alleged to have been made, in the great storm of April last, in that harbor. The verification of the hydrography did not show such changes. The party next completed the hydrography of Salem harbor; and the means disposable for this portion of the work being exhausted, the steamer was laid up at Boston, and the officers, detailed for office duty, reported for the discharge of it at the Coast Survey office in Washington. The supplementary report of Lieutenant Commanding McBlair states the work in Salem harbor as follows:

"The survey embraces the harbor and approaches of Salem, Beverly, Manchester, and Marblehead.

"It has been executed almost altogether in boats, and necessarily with more than usual minuteness, in consequence of the numerous ledges and shoals which obstruct the passages.

"We commenced operations on the 3d instant, and finished on the 15th. The following table exhibits the amount of work performed, and the results obtained:

Area within limits of sounding lines	21 square miles.
Number of miles of soundings	176
Number of casts of lead	7,424
Depth of water sounded in	from 3 feet to 23 fathoms.

"Observations were made in the main ship-channel, to determine the direction and force of the current."

Lieutenant Commanding Swartwout, in the brig Washington, was detached, for a part of the season, in this section, upon the survey of No-Man's-Land channel, between the island of that name and Martha's

Vineyard island, and also upon off-shore soundings, between the meridians of Gay Head and Beaver Tail.

The survey comprised an area of 14 square miles, in which 1,200 soundings were made, and 81 angles observed, the depth of water varying from 8 feet to 11 fathoms. The off-shore work consisted of 160 soundings, over 3 lines, the total length of which was 176 miles.

In execution of his instructions, Lieutenant Commanding Woodhull, United States navy, assistant in the coast survey, in the schooner Madison, has occupied 8 stations in the Vineyard sound, (see sketch A,) and 2 at the entrance of the passages between Buzzard's bay and the sound, for currents, and 9 stations for tides. The tidal observations, during two lunations, were made at eight points as nearly identical as practicable with those at which partial results were obtained last year, and after this period two of the gauges were removed to points near the middle of the length of the passage, Quicks' and Wood's Holes, and simultaneous observations were again made.

Lieutenant Commanding Woodhull states, in his report:

"During the observations I had all due care and attention paid to the regulation of the time. I visited the stations frequently, to see that the duty was faithfully and carefully performed. The books have been well kept; observations of wind and weather have been made at all the stations. The barometer and thermometer have also been recorded with great care, both at Quicks' and Wood's Holes; in fact, I feel satisfied, as far as I could control circumstances, nothing has been neglected to insure favorable results. The tidal observations have been conducted agreeably to your directions in every respect, save observing them every hour for three consecutive days. I made all my arrangements to comply with your instructions in this particular, but did not succeed, owing to the constantly unfavorable state of the weather during nearly the whole of the time comprised in the two lunations."

The current observations made are thus referred to; (see also sketch A):

"In connexion with the above, the observations of currents received my attention, and, I think, will prove satisfactory. The currents were observed during the first lunation at Nos. 2, 15, 16, 17, 18, 19, and 20. On the second lunation, Nos. 3, 7, 10, 15, 16, 17, 18, and 19.

"When the stations were occupied the weather was calm, occasionally foggy, with a rather smooth sea. This state of the weather, though not highly favorable, was sufficiently so to ascertain the correct directions and force of the currents. Four consecutive tides were taken at each of these stations, two ebbs and two floods, and the velocity on the surface and fifteen feet below it. You will perceive I did not fail to take advantage of all the good weather that offered, and the results have been nearly twice that of last year, and four times as great as those of the year before."

The number of observations of tides was 2,817 during the year, and of currents 978 on 16 days.

Leaving the tidal observations in charge of a part of the officers of his party, Lieutenant Commanding Woodhull proceeded to Chatham harbor and made the preliminary survey to which I have already alluded.

The party next executed the soundings of the approach to Portsmouth harbor, New Hampshire, and of the intricate channel behind the navy-yard at Kittery, Maine. The area of the off-shore work was 77 square miles, extending to the Isle of Shoals; 231 miles were run in sounding, 4,150 casts of the deep-sea lead made, and 380 angles for position observed. Lieutenant Commanding Woodhull states that the irregularities of the bottom are such as to render the soundings of comparatively little value in determining the position of a vessel on this part of the coast in thick weather. The tides will be observed at Portsmouth during at least two lunations.

The harbor of Newburyport, Massachusetts, and the approaches, have also been sounded out, by this party, seaward, between three and four miles, and about two miles and a half on both sides of the entrance. "The inside work extends from the bar to about a mile and a half above the railroad bridge; in all, a distance of three and a half miles, varying from three-eighths to one-half a mile in width." The area embraced is 20 square miles, in which 7,500 casts of the lead have been made, 175 miles have been run in sounding, and 632 angles for position observed. Tidal observations will also be kept up at Newburyport.

Lieutenant Commanding Woodhull is now (October 15) under instructions to proceed to Connecticut river for the re-examination of the entrance, and the work done will be stated in his supplementary report.

In his report of the season's work, Lieutenant Commanding Woodhull pays a well-merited compliment to the zeal and industry of the officers of his party, through whom so large an amount of work has been accomplished.

Section II.—from point judith to cape henlopen, including the coast of connecticut, new york, pennsylvania, and part of delaware.—(Sketch B.)

The field-work of this section has been of the usual miscellaneous character; parties being occasionally occupied, as they could best be spared from other sections, in filling up portions remaining unexecuted, or in revision where it has been found necessary. The office-work has advanced according to the estimates and plans for it at the beginning of the year; and the details will be found under the head of "Office-work" in this report. Eighteen finished maps and charts have been published of this section, (three of which during the year,) besides two sketches.

In the immediate necessity for practical results for our work, it is often expedient to postpone questions of interest, which have a less important bearing, and yet without the solution of which the survey will be incomplete. Of this character is the question of tides and currents at a distance from the coast, but within the limits proper to the hydrography, the form of the bottom of the sea, and the like. Sections were made two years since for the off-shore map, embracing the space between Gay Head and Cape Henlopen, which showed the curious result of the sudden and rapid slope of the bottom of the sea, after the depth of one hundred fathoms was reached. This year I have attempted the other question, and have given the necessary instructions for its solu-

tion at stations within the limits of the same chart, but the stormy character of the season has materially interfered with their execution.

This off-shore chart being the first of a series, the mode of arranging the details has occupied much attention; and each case requiring study, and not being a matter of routine, much more time has been unavoidably consumed than will be necessary in another chart. Successive improvements have been made, rendering the chart more valuable, but tending to delay the publication. It is now, however, certain that all the essential data for publication have been procured, so that a first edition can be issued; leaving those refinements which it is proposed to introduce till a later period.

The items in the light-house bill referred to me for examination, under the law of March 3, 1851, by the instructions of the Treasury Department, were the following:

"*Connecticut.*—For a can-buoy on Peafield reef, off Black Rock harbor, in Long Island sound, in addition to a former appropriation in the act of September, 1850, one hundred and thirty-five dollars.

"*New York.*—For a light-house on Flynn's knoll, near Sandy Hook, thirty thousand dollars.

"For a light-house on the northern extremity of Gardiner's island, six thousand dollars.

"For the completion of two beacons near Fort Hamilton, two thousand dollars.

"For a beacon on the Sand Spit, in the harbor of Sag Harbor, seven hundred dollars.

"For four spar-buoys at Fire Island inlet, three hundred dollars.

"*New Jersey.*—For a fog-bell at the Newark light-house, two hundred and fifty dollars.

"For the completion of the beacon in Passaic river, four spar-buoys in the same, a spar-buoy at Mill Rock, and a beacon at the Corner Stake, near Elizabethtown Point, eight hundred dollars."

The spar-buoys for Fire island having been recommended by me on the report of Lieutenant Commanding Woodhull, the recommendation was simply repeated.

An examination of Flynn's knoll by the Light-house Board, raised a doubt as to the expediency of placing a light-house on that shoal. I suggested the alternative of range-lights, similar to the one approved for the main ship-channel, from its elbow near the Southwest Spit shoal through the Narrows—(see report to the Secretary of the Treasury in Appendix No. 23;) one set of ranges to lead from the entrance from Gedney's channel, through the main ship-channel, to the range for changing course to northward; another range to lead through the Swash channel, the importance of which cannot be exaggerated. The project includes the substitution of a beacon-light for the Elm Tree beacon. The two small beacon-lights required by this plan for the main ship-channel will be screened by the woods, through which the range lines will be cut at Point Comfort, (see sketch B, No. 5,) on the New Jersey shore; or artificially, so as to be seen on the range, and at a moderate distance on each side only. The same precaution will be taken in regard to the Swash range, so as to avoid confusion from multiplying the number of lights. A distinction of colors may also be in-

troduced with advantage. The first range requires the lights to be seen at from eight to ten miles, and the second at about six and a half and eight and a half miles. The beacon-lights at Fort Hamilton must be seen eight miles.

Items numbered nine (9) to nineteen (19) inclusive, were referred to Lieutenants Commanding Thornton A. Jenkins and Maxwell Woodhull, United States navy, assistants in the coast survey, for examination and report. On the information received from them I reported, (June 13,) recommending the buoy on Peafield reef, No. 9; a light-house on Gardiner's island (No. 11,) to show a red light; the beacon in Sag Harbor, (No. 12;) the two beacons near Fort Hamilton, New York harbor, (No. 13;) a fog-bell for Newark light; the beacons in Passaic river (No. 14;) and the beacon near Elizabethtown Point.

The four buoys (No. 14) in the Passaic river and the one on Mill Rock were found to have been already placed. An additional buoy off Black Rock harbor (Connecticut) was recommended, for which no appropriation had been made.

My report to the Treasury Department, together with the reports of Lieutenants Commanding Jenkins and Woodhull, are in the Appendix No. 24, and show the reasons for these recommendations. The maps referred to are published maps of the coast survey, which embrace the localities named, upon which the positions designed for the beacons and buoys were marked. No new surveys were required in these cases, but merely an examination of the localities with the charts in hand, by persons acquainted with the details of such work.

The different operations in this section will be briefly noticed in their order:

1. The triangulation of the Hudson river has been continued by assistant Edmund Blunt, aided by Lieutenant Joseph S. Totten, United States army, assistant in the coast survey, and during a brief period by assistant W. E. Greenwell. The connexion with the former triangles was made through stations Diddery and Buttermilk Hill; the scheme has been extended to Bear Mountain, (see sketch B.) This party, having supplied points for the hydrography of the entrance to the Chesapeake, was temporarily withdrawn from Section III, during the part of the season unfavorable for primary work there, and has made the following determinations: for primary triangulation 49 angles, and for secondary triangulations 213 angles, have been measured by 2,357 observations.

The work in the Chesapeake was resumed in November.

2. The following observations were made for the coast survey at the observatory of the Central High School, Philadelphia, by Professor E. O. Kendall, for longitude:

"Forty-five transits of the moon have been observed, of which twenty-nine were of the *first* limb, and sixteen of the *second*. In most cases four moon-culminating stars were observed, and as many of the fundamental stars as were necessary for the determination of the corrections of the instrument, and that of the clock. The number of occultations observed during this period is seven. This is a smaller number than usual; and it may not be improper to say, by way of explanation, that during the first half of this year (1851) the prevalence of cloudy

evenings was unprecedented, as far as my experience goes. The *beginning* and *end* of the solar eclipse of July 27 were successfully observed here by Mr. Riggs and Mr. Mason, the former using the nine-feet equatorial, and the latter the two-and-a-half-feet Dyalitic telescope.

"I have, also, with the assistance of Mr. Andrew Mason, completed the reduction and copying of all the observations made at this place up to the close of the year 1850, and have forwarded them to the office of the Coast Survey. The work of reducing the observations of 1851 is in such a state of forwardness that I shall be able to get them ready for your use soon after the close of the year. The results of those obtained from January to June inclusive, will, as requested, be sent to Washington in a few days, for comparison with Mr. Davidson's at San Diego." The closing remark refers to the immediate use of these observations in determining the longitude of the coast survey station at San Diego.

3. Assistant J. B. Glück executed in July the minute topographical surveys required to determine the location of range-lights for the main ship-channel and for the Swash channel into New York harbor. These were made at a very trifling expense in consequence of the kindness of the collector, Hugh Maxwell, esq., in permitting the use of the revenue cutter Taney, and of the promptness of Captain Rudolph in rendering us assistance. For Mr. Glück's report, see Appendix No. 23.

4. A re-survey has just been made of Sandy Hook for determining the changes in that point; and permanent marks, of a suitable kind, were placed, as recommended in a report of a previous year, by assistant H. L. Whiting, by which the changes may very readily be ascertained from time to time. The re-survey was made under the immediate direction of Mr. Whiting, by Mr. R. M. Bache. The results are shown in connexion with those of former years, on sketch B, No. 4.

5. The verification of the hydrography required for the third, or eastern, sheet of the chart of the south side of Long Island was executed at the close of May last by Lieutenant Commanding Maxwell Woodhull, United States navy, assistant in the coast survey, in the schooner Madison. The work extends from Neapeague to Montauk Point, (see sketch B,) and was carried out about nine miles from the shore. The area was 117 square miles, in sounding which, 332 miles were run, 4,800 casts of the lead made, and 422 angles for position measured. The party was then transferred to the Vineyard sound for tidal and current observations, which have been already reported in connexion with the other work of Section I. Professor Pendleton, United States navy, assistant in the coast survey, assisted in the measurement of angles from the shore stations, required in this work.

6. Deficiencies in the hydrography of the entrance to Connecticut river having been reported, Lieutenant Commanding Woodhull was instructed to proceed there early in the season, and after filling up the work required, and examining the bar at the entrance, recommended a re-survey, which was accordingly directed. On completing his work in Section I, (hydrography of Newburyport harbor, Massachusetts,) he proceeded to Connecticut river, of the entrance and bar of which he has made a careful survey. As soon as the soundings are plotted, sailing directions will be published, and the sheet reduced for engraving.

A record of the tides, day and night, was kept here.

7. The removal of certain of the reefs in the dangerous passage of Hell Gate having been resolved upon by enterprising citizens of New York, it appeared desirable that the reefs should be minutely examined before and after these operations, and that the changes in the hydrography of the passage should be carefully noted. Lieutenant Washington A. Bartlett, United States navy, assistant in the coast survey, was detailed for this purpose, and made minute surveys of Way's reef, Pot Rock, the Gridiron, and Hallet's Point; the first two being made in October after the first blastings, and the second before any such operations had been attempted. For his reports, see Appendix No. 56.

To the perseverance and urgency of Eben Meriam, esq., of Brooklyn, the liberality of Henry Grinnell, esq., and others, of New York, and the skill of Mr. Maillefert in submarine blasting, the city of New York will owe an undertaking which has already so far succeeded as to render it almost certain that the dangers of this formidable passage may be essentially diminished, if not entirely removed.

The Coast Survey chart of Hell Gate, and its approaches, will be modified in accordance with the changes which may be developed, and the first edition will serve as a historical record of no small value and interest.

8. Lieutenant Commanding S. Swartwout, United States navy, assistant in the coast survey, was detached with the brig Washington, for a short time, to make the hydrographic survey of the vicinity of Cox's ledge, which is some twenty-one miles from Block island. Thirty-four miles of soundings were run over, and sixty-eight soundings procured, in from 16 to 24 fathoms water.

9. Valuable reports have been received from the Hon. H. C. Murphy, of Brooklyn, on the names upon the Coast Survey map No. 1, of Long Island sound, including both shores, giving the orthography and derivation of some 270 names. This is in continuation of his reports on sheets Nos. 2 and 3 of the same map.

10. In my report of 1849, I noticed the operations for determining, by telegraph, the difference of longitude of Seaton station (Washington) and Western Reserve College, with a view to render available for the longitude of one of the Coast Survey stations the elaborate series of moon-culminations observed by Professor Loomis, (now of New York University,) between the years 1838 and 1844.

It was found impracticable to transmit the signals to and from Washington, but from and to Philadelphia the telegraphic connexion with Hudson was complete on several nights during the time set apart for the work.

The telegraph and other observations have since been reduced under the direction of assistant S. C. Walker, who deduces from them the longitude of the observatory of Western Reserve College, Hudson, Ohio, west of the High School observatory, Philadelphia, 25*m*. 5.70*s*.

11. The results of the observations for difference of longitude between the Seaton station, Washington, and the High School observatory, Philadelphia, made in the summer of 1849, have been computed by assistant S. C. Walker, or under his immediate direction. They

consisted of the exchange of chronometer signals and of star signals, and, with the weights assigned to the different classes of observations by Mr. Walker, give the difference of longitude 7*m.* 20.90*s.*

SECTION III.—FROM CAPE HENLOPEN TO CAPE HENRY, INCLUDING THE COAST OF DELAWARE, MARYLAND, AND PART OF VIRGINIA.—(Sketch C.)

Seven land parties have been employed in this section during the season, either in whole or in part; one, a double hydrographic party throughout, and another for a portion of the season. The astronomical observations for connexion of the Capitol with the coast have been finished; and a scheme devised, after reconnaissance, for connexion of the Chesapeake with the seacoast triangulation. The primary triangulation of the Chesapeake has been extended from the limits of last year towards the Capes, at which some preliminary determinations have been made, embracing in area more than half of all that remained to be completed at the time of my last year's report.

The system of connexion, by telegraph, of Washington with distant points of the coast for difference of longitude, has been prosecuted. The secondary triangulation has extended along the peninsula of Virginia, from Cedar island to Rogue's island on the Atlantic coast. The topography of the Patapsco river has been revised. Other topographical surveys have covered part of the seacoast of the peninsula of Maryland and Virginia; and both shores, with the islands of the Chesapeake bay, in that portion including Pocomoke sound on the east, and lying between the Potomac and Rappahannock rivers on the west.

The hydrographic operations have advanced along the outer shore of Virginia, from a point in Maryland near the line, to within about forty miles of Cape Charles, including important shoals on the coast, and extending seaward a distance of about eleven miles. They have likewise been continued in Chesapeake bay; and a special survey, of which the results are made public in a sketch herewith, has furnished valuable information in regard to the approaches (middle ground) of that bay.

Astronomical observations, &c.—Causten's station, near Georgetown, D. C., was occupied during May and June by my party, for the determination of latitude and azimuth. Magnetic observations were also made, and an angle in one of the secondary triangles measured, to furnish a base for continuing the survey down the Potomac. The observations were made, under my immediate direction, by sub-assistant George W. Dean; and the following table shows their number and kind, and the instruments with which they were made:

Observations for—

Time.—Transit No. 4, (Troughton & Simms,) 102 observations on 12 pairs of stars.

Latitude.—Zenith sector, C. S. No. 1, (Troughton & Simms,) 366 observations on 80 stars.

Azimuth.—30-inch theodolite, C. S. No. 1, (Troughton & Simms,) 130 observations on Polaris.

Magnetic.—Variation, declinometer C. S. No. 1, by Jones, 77 observations on five different days; intensity, declinometer C. S. No. 1, by

Jones, 3 sets on three different days; dip, 10-inch dip-circle by Gambey, 3 sets on two different days.

The stars used in the latitude observations were selected from the Greenwich twelve-year catalogue, for which we are indebted to Professor Airy.

The micrometers of the zenith sector were compared with the divisions on the limb of the instrument, giving the same resulting mean value as was obtained last year.

The azimuths were in part observed at elongation and in part at culmination, by the method referred to in my last report. They were referred to a mark placed nearly in the line to Soper's station, (Montgomery county, Maryland,) and the angle between the mark and the signal at Soper's was measured by the micrometer.

During the months of July and August, moon culminations were observed at the Seaton station by Mr. J. C. Langton, under the direction of assistant S. C. Walker, by the galvanic method.* In his annual report, Mr. Walker brings up the results of the investigation of the rate of transmission of the signals through telegraph lines (galvanic wave time) to the present date. "The results of our experience to October, 1850, were then stated to be—

"1st. That the average of all our experiments to that time indicated a velocity of propagation of the galvanic wave of 15,400 miles per second in the iron wires of a telegraph line.

"2d. That the velocity of propagation through the ground appeared to be less than two-thirds of the velocity in the iron wires."

During the year, three new results have been added to the foregoing, two of them obtained incidentally while determining differences of longitude. The first, between the Seaton station, Washington, and Portsmouth, Virginia, when the distance through the wires was 268 miles, and through the ground 180 miles; the second, between Charleston, South Carolina, and Savannah, Georgia, passing through Augusta, the length of the circuit of telegraph wires being in this 447 miles. In the third, from Cincinnati and back, the circuit consisted of 840 miles of iron wire, there being no ground connexion. From a comparison of all the results, Mr. Walker draws the conclusion that the time of traversing 15,461 miles is one second. As these experiments have attracted much attention, at home and abroad, among scientific men, and afford the data for examination of questions in regard to the propagation of the galvanic influence which are of high interest, I have placed Mr. Walker's report, entire, in the Appendix No. 25.

The telegraphic operations for determining difference of longitude between Seaton station and Forbes' point, North Carolina, and the general arragement for those between Charleston and Savannah, were under the charge of assistant Sears C. Walker. An account of these has been given, in the proper place, in Sections IV and V. In addition, he has been industriously occupied in reducing and superintending the reduction of his telegraph results, and of the longitude observations of others.

* This is termed by Mr. Airy, the Astronomer Royal of Great Britain, the "American method."

During the year, the telegraph work of 1846 and 1847 has been discussed by him, using the best values for personal equations, and he now reports the discussion as final.

The work of 1848, between Washington, New York, and Cambridge, has also been finally discussed, and the geodetic corrections applied. That between Philadelphia and Cincinnati, in 1849, Philadelphia and Hudson, and Seaton station and Charleston, in 1850, is also reported as complete; and the results of observations of moon culminations and occultations at Hudson, by Professor Loomis, have been used in determining the longitude of Cambridge.

The following extracts from Mr. Walker's annual report will show the progress of the computations of moon culminations, &c., under his charge:

"In the course of the last year additional corresponding moon culminations have been found for Mr. Hilgard's work at Sand key, Florida, Section VI, and reduced and reported.

"The observations of assistant Davidson, at Point Conception, Upper California, Section X, of moon culminations, have been reduced and compared with those made at Philadelphia and Cambridge. The longitude of Point Conception has been obtained and reported."

* * * * * * * *

"No progress has been made in the further reduction of the collection of occultations and eclipses of the coast survey. I recommend that these be compared and reduced, with the recent improvements in the lunar theory, in particular including that of Mr. Myers Fisher Longstreth, of Philadelphia.

"The work of reducing the moon culminations of the coast survey has been continued by Professor Pendleton, with the assistance of Professor Yulee and Mr. Keber. Nearly all the work at Hudson, Ohio, has been revised; and in instances where Lieutenant Gilliss, United States navy, and Professor Loomis differ, a triplicate computation is made. A part of the work of Lieutenant Gilliss, United States navy, has been submitted to a duplicate computation.

"Professor Pendleton's work has been, thus far, limited to the years 1841 and 1846."

* * * * * * * *

"Corresponding observations of moon culminations only have been hitherto reduced, in consequence of the state of the lunar theory. The recent improvements in that theory by Hansen, Airy, Longstreth, and Peirce, make it desirable to compare all our observed moon culminations with theory alone. Where corresponding observations are available, it is well to compare also with observation. It will serve as a test of the recent improvements, and may, perhaps, serve to throw some light on the discrepancy which now exists between the longitude by moon culminations and by chronometers.

"We are relieved from the necessity of reducing the numerous observations of the recent solar eclipse, by the amateur computations of Professor Peirce."

Referring to the results of the various chronometer expeditions, reported since 1844 by Mr. Bond, director of Harvard observatory,

including the special expeditions of the Coast Survey to Liverpool, Professor Walker remarks:

"I am convinced that there is no possible interpretation of them which will place the results below his reported value, 4*h*. 44*m*. 30.1*s*., for the longitude of Harvard observatory from Greenwich observatory.

"The longitude of Harvard observatory, by moon culminations at Harvard observatory, Dorchester, Hudson, Wilkes' observatory, and the Washington observatory, comes out very uniformly about 4*h*. 44*m*. 28.4*s*., leaving a discrepancy below the results by chronometers of 2.7*s*. This discrepancy will, I hope, be explained in time by persevering efforts."

Mr. Walker gives an abstract of his report on longitude, which will be found in Appendix No. 26.

A meteorological register was kept at Causten's station, by Mr. B. F. West, recording, for thirty-two days, observations for temperature of the air, moisture, atmospheric pressure, and the force, amount, and direction of winds and clouds.

Reconnaissance, primary triangulation, &c.—Major Henry Prince, United States army, assistant in the coast survey, made, during the earlier part of the season embraced in this report, an extended reconnaissance of the eastern shore of Maryland and Virginia—the purpose of which was to arrive at a mode of connecting the secondary triangulation of the Atlantic shore with that of the Chesapeake. The results of his examination show great difficulties in making the connexion high up the peninsula, for want of suitable natural elevations for signals, and on account of the heavy cutting involved in the use of any station on the main land. It therefore appears advisable, as it is reported practicable, to make the connexion by observing from island stations on either side—upon Drummondtown or some point where the peninsula is narrow—or to postpone the connexion until Cape Charles is reached by the Chesapeake and by the outside triangulations.

From this reconnaissance, Major Prince passed to that of Pamplico sound and others of importance.

Assistant Edmund Blunt, with a party for primary triangulation, was engaged in the lower part of Chesapeake bay for the greater part of three months, June to August; afterwards proceeding north for the triangulation of the Hudson river, and returning to this section in November. Mr. Blunt's operations in this section were the observations for triangulation and the reconnaissances appropriate to form a judicious scheme, and to establish points for hydrographical and topographical purposes. The triangulation of the season extends from Wolf Trap station (intermediate between York and Rappahannock rivers) south towards the entrance of Chesapeake bay, at which some preliminary determinations were made. A reference to the general sketch C, will show that it has adopted as primary points the principal capes and light-houses. Care was taken in all cases to mark the points used in a permanent manner for future reference.

The statistics of Mr. Blunt show 18 primary angles measured, and 67 others—in all, 136 series of angles were measured by 1,478 observations. The season's work covered an area of 400 square miles.

Secondary triangulation.—Assistant John Farley has continued this portion of the work along the outer coast of Virginia. His party, en-

gaged during October and November, 1850, and June, July, and August, 1851, suspended operations at the end of August on account of health, but returned to the field in October. In the intervals of withdrawal they have been occupied in the computation of previous work.

The triangulation has been continued (see sketch C) from Joynes' station, near Drummondtown, Accomac county, to Sand shoals, opposite Eastville, in Northampton county, Virginia, and within about 18 miles of Cape Charles. It covers an area of 150 square miles, "by the occupation of 10 stations, with 42 angles, and 1,100 intersections, on 51 lines of sight."

Mr. Farley adds that, at the request of the Fifth Auditor, Mr. Pleasanton, "a point has been incidentally established upon the public reservation for a light on Hog island, in Northampton county—subject to be received as the centre of the proposed light-house; which point, if accepted, will have determined the latitude and longitude of the same."

Assistant Farley was aided by Mr. George H. Bagwell.

Topography, (sketch C.)—Four plane-table parties (one of which was double) have been in the field during the available portions of the year. Their operations have been as follows:

1. After the date of my report of last year, and in April, May, and June of the present year, assistant J. B. Glück continued the revision of the topography of the shores of the Patapsco. His sheets comprise an area of 26 square miles, and an extent of shore-line of 98 miles. The Coast Survey schooner Nautilus was assigned as a means of transportation for his party. Mr. Glück is now (October 15) under instructions to return to this section for the completion of this work, which is essential to the publication of the chart of Baltimore harbor and the Patapsco river, already delayed by circumstances which could neither be foreseen nor controlled.

2. A double topographical party was in the field under sub-assistant John Seib until the latter part of December, 1850; was then occupied in office work, and resumed its field duties in May, 1851. Sub-assistant S. A. Wainwright returned to this party in August, having been meantime in section V. Mr. G. W. Parrish and Mr. John H. Wise have been aiding Mr. Seib. The party have had in use the Coast Survey schooner Wave. The topography executed this season in the Chesapeake bay, including the interior of the coast between the Potomac and Rappahannock rivers, extends over the latter, and along the shore to within a few miles of York river, and on the opposite coast covers the shore and islands from the immediate vicinity of the Maryland line southward to a point about 15 miles from Cape Charles. Mr. Seib's account of the progress and general character of the work is given more in detail, by reference to the numbers of the plane-table sheets, as follows, (see general sketch C):

Sheets Nos. 40 and 41, (western shore between the Potomac and Rappahannock rivers,) and Nos. 42 and 43, (eastern shore and islands of Pocomoke sound, and the neighboring portion of the Chesapeake,) were completed during the fall and winter of 1850.

Sheets Nos. 46 and 47 embrace the survey of the main shore of Chesapeake bay, from Windmill Point to Wolf Trap, the shore of the mouth of the Rappahannock, on the north for three miles, and on

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the south for two miles, with the topography of Hill's bay, Milford Haven, Gwinn's island, and Stingray Point. The country is slightly elevated, intersected by creeks, coves, and ponds, and thickly settled.

No. 48, embracing the main eastern shore of the Chesapeake bay, from Sandy Point to Rose Mary, furnishes its topography, and that of the creeks included. The country is in part even and swampy—in part sandy and slightly uneven. The banks along the main shore vary from five to twenty feet in height.

No. 45.—This sheet is completed, comprising the shores and topography from Sykes' island to Deep creek. A portion of this work was executed by Mr. Wainwright.

Mr. Seib furnishes the following statistics for the year:

Shore-line of bay, sound, creeks, and coves.........433 miles.

Area of country.................................... 91 square miles.

The office-work of the party (in which Mr. Seib and Mr. Wainwright were occupied during the winter and spring of 1851) consisted in inking and lettering the plane-table sheets of the previous season.

3. The statistics above given do not include the separate operations of sub-assistant S. A. Wainwright, who entered in August upon the topography of the eastern (Chesapeake) shore of Virginia, having been previously engaged in another section. His work for the season, up to October, is embraced in the plane-table sheet No. 45. It extends from Sykes' island to Guilford signal, along 44½ miles of shore-line. Mr. Wainwright is going on with Pocomoke sound, and will pass, if practicable, to the western shore of Virginia, before the close of the season.

4. Assistant G. D. Wise, after closing his work on the coast of South Carolina, passed, May 8, to the survey of the Atlantic coast of Maryland and Virginia. The party was broken up about the first of July, by the sickness of Mr. Wise and some of his men.

The season's work is included between Lonesome Hill station, on the coast of Maryland, near the Virginia line, and Chincoteague inlet, Virginia, extending over fourteen miles of coast, along fifty miles of shore-line. The area embraced is twenty-five square miles.

Assistant Wise returned to the field, and took charge, October 15, of the party on the Atlantic coast of Virginia, whose operations I am next about to notice.

5. Mr. W. M. Johnson having been engaged from December, 1850, to June, 1851, in Section VIII, as aid to assistant Greenwell, and subsequently in office-work pertaining to that section, was transferred, August 12, to a party in Section III, (then under sub-assistant J. M. Wampler,) of which, in a few days after, he succeeded to the charge. His work, up to October, embraces Wallop's and Assawaman islands, and a portion of Matomkin, extending south to the point marked South Gargathy, on the seacoast of Virginia, running inland a mile and a half, or two miles, (far enough to give an accurate idea of the topography of the entire back country) and being the continuation southward of the work just reported as executed by assistant Wise. It embraces an area of 21 square miles, and extends along 65 miles of shore-line, and 6 of roads.

On the general character of this portion of the coast, Mr. Johnson remarks: "The main land is about twenty feet above the level of the

ocean, sloping gradually from the water's edge. Between the islands and the main land lies a body of marsh, intersected by numerous creeks, bays, &c., and which is overflowed at every high water."

Hydrography.—Lieutenant Commanding John J. Almy, United States navy, assistant in the coast survey, has prosecuted, during the greater part of the season, the outside hydrography of the seacoast of Virginia. The steamer Legaré and the schooner Graham, belonging to the coast survey, have been placed under his command for this service. The state of the season rendering it dangerous to continue outside work with the steamer, the vessel and party were transferred early in September to the hydrography of Chesapeake bay. The Graham being of such light draught as easily to secure shelter in the inlets, was left outside to do some filling up and finishing off with her boats—thence to pass to the bay, and carry on the inside soundings there.

The character and progress of the work may be gathered from the sketch C, No. 3, (on which it embraces the coast between the points marked Lonesome Hill and South Gargathy,) and from the following description by Lieutenant Commanding Almy:

"I have completed the outside work down to South Gargathy, and in a direction southeast by east from this point, a distance of eleven miles seaward, where the tops of the trees in a clear day can just be seen from the deck of the steamer—the land being very low about here. This makes for my outside work this season eighteen nautical miles of in-shore soundings by the coast to the southward; and twenty miles from the southeast point of outside soundings last year to their termination point of this year.

"The season's work has covered Chincoteague shoals, and been brought into smooth, regular soundings, which continue down to the Chesapeake bay. These Chincoteague shoals appear to be the terror of all navigators who have to pass anywhere near them; and frequent inquiries have been made of us respecting their survey. The soundings which embrace all of these shoals are now completed."

The hydrographic work in Cheasapeake bay, resumed by Lieutenant Commanding Almy, September 20, was continued until late in November. Its progress is thus described, (see also sketch C):

"The soundings in Chesapeake bay have been entirely completed as far down as a straight line drawn—which is very nearly due east and west—from Windmill point, (point of triangulation,) on the west side of the bay. Then south of the east and west line, on the west side of the bay. The soundings have been completed as far down as Wolf Trap, (point of triangulation,) and on a line due east from this, as far as the meridian of 76° 04′, which is about two-thirds of the way across the bay from the west side."

The following statistics of the work are reported by Lieutenant Commanding Almy:

	Seacoast work.	Baywork.
Area sounded, out, square miles	286	247
Number of soundings made by steamer and boats in from 1 to 17 fathoms	31,052	28,610
Length of lines run in sounding, nautical miles	1,192	849

	Seacoast work.	*Bay work.*
Number of angles taken for hydrographic positions by theodolites	4,589	2,187
Number of ditto by sextants	1,425	1,594
Number of current stations occupied	3	2
Number of current observations taken	129	255
Number of tidal observations made	2,662	1,187

In the outside soundings, 27 different specimens, and in the inside 13, have been obtained and placed in bottles, in duplicate, provided at the Coast Survey office. A sketch of the outside hydrography, executed by Lieutenant Commanding Almy, will be published immediately. From the indications afforded by the track of three bottles, which were thrown overboard by Lieutenant Commanding Almy at different times, with dates marked, and which have since been picked up, it would appear that there is a general southwesterly current setting along the eastern (Atlantic) coast of Virginia, but quite moderate in strength.

On his return from Section VIII, Lieutenant Commanding B. F. Sands, United States navy, assistant in the coast survey, was directed to commence the survey of the approaches to the Chesapeake; and the steamer Walker, which he had used in Louisiana, requiring repairs, the Coast Survey schooners Nautilus and Meredith were assigned for his work. The arrangements for the transfer of the crews of the vessels were made by the 13th of August, and the work continued until the close of September. The following extract from the report of Lieutenant Commanding Sands will show what has been accomplished:

"As the season was so far advanced that it was not probable we would have much good weather to complete any particular part of the section, I determined to run as many lines of soundings as possible over the 'Middle Ground' between the capes, confining myself to the shoal water, as that part was least known, even to the pilots.

"The weather was not favorable to very extensive work—the easterly winds, prevailing, made it frequently too rough for sounding; but we succeeded in running two hundred and sixty-eight miles of soundings, and in making ten thousand two hundred and thirty-eight casts of the lead in an area of sixty-five square miles, which will show the general configuration of a part of that great thoroughfare hitherto so little known. The tides were observed at two stations, and two positions occupied for preliminary current stations; the weather preventing further observations upon the currents, as was intended.

"A short season of smooth weather would enable us to finish this interesting portion of the approaches to this extensive bay, a knowledge of which would be of the greatest importance to the commerce of the Chesapeake and James river. The unfavorable weather would not admit of so extended a survey as to enable me to make reliable sailing directions; but the publication of a preliminary sketch of the work done would prove interesting to the commercial community."

The recommendation with which the extract closes has been adopted, and the sketch will be reduced and engraved to accompany this report, (sketch C, No. 2.) It is due to Lieutenant Commanding Sands and his

officers to say, that though they had just returned from arduous service in the Gulf of Mexico, there was no abatement of zeal and industry in the prosecution of the new duty assigned to them, as, indeed, the statistics of the work just given most amply prove.

Light-houses, &c.—In accordance with the instructions of the Treasury Department, pursuant to an act of Congress, Lieutenant Commanding J. J. Almy, United States navy, assistant in the coast survey, was directed to make an examination of the necessity for a light-house at Fishing battery, otherwise called Donaho's battery, in Chesapeake bay, near Havre de Grace, Maryland. His report, and my recommendation or the erection of a light-house, will be found in Appendix No. 27.

Section IV.—from cape henry to cape fear, including the coast of the state of north carolina.—(Sketch D.)

Two parties for triangulation and one for hydrography have been employed, during the whole of the past season, in this section; and during a part of it, in addition, a reconnaissance party and two hydrographic parties. The secondary triangulation of the season covers the greater part of Currituck sound; and the tertiary extends from Hatteras light to a point south of Ocracoke inlet. A general reconnaissance of Pamplico sound has prepared the way for the main triangulation. With this was united an examination of Core sound. The hydrography of Albemarle and Croatan sounds, remaining from the previous year's work, and that of Roanoke sound, have been completed; as also, in part, that of Currituck sound. Oregon inlet, which opened in 1846, was re-examined, to ascertain its progress.

The reports of the officers engaged in these surveys contain matter locally and generally interesting, which will be mentioned or quoted in due connexion. Reports upon Cape Fear river and Beaufort harbor, in reference to location of lights and buoys, will also be presented in their place.

To obtain the difference of longitude of a point in this section from Washington, the telegraphic connexion with Portsmouth, Virginia, was used, and chronometers transported from thence to Forbes' Point, near Elizabeth City, in North Carolina. Portsmouth is an important locality in the geodetic operations of the survey, as the southern extremity of the arc of the meridian which passes northward over the Chesapeake to the Delaware, and the measurement of which has now nearly been completed in the regular progress of the survey.

The drawing of one sheet of the general chart of Albemarle sound has made considerable progress, and that of Beaufort harbor is complete, and ready for engraving. Sketches of Hatteras shoals, Hatteras inlet, and Beaufort harbor, accompany this report, and provision has been made for engraving those of the entrance to Cape Fear, and the Fryingpan shoals off Cape Fear, as soon as sent in to the office.

It appears from the examination of Pamplico sound that it contains a number of excellent harbors, often needed for refuge, yet scarcely used from want of acquaintance with their intricacies.

The channel of Core sound, sounded in accordance with a special request of the legislature of North Carolina, was found to have undergone no substantial change.

Oregon inlet, which has been watched with interest as holding out hopes of a new entrance important to the navigation of Albemarle and Pamplico sounds, does not, in its present state, afford much encouragement to such an idea.

The harbor of Beaufort appears to be less liable to deterioration than other points on this part of the coast, and may be pronounced equal, in its security and natural facilities, to any port of our eastern coast south of the Chesapeake. It allows 17 feet to be carried in at low water.

A survey has been made of the Fryingpan shoals, (of which there appears to have been heretofore but little correct knowledge,) and of the approaches to the bars of Cape Fear river. The description of the shoals and channels, and the recommendations on the subject of lights and buoys, resulting from this examination, will be found at length under their proper head. A survey of Cape Fear river, interior to this, is also in progress.

An examination of Hatteras inlet has been made, in reference to which it is reported that "No important perceptible changes had taken place on the bar or in the channel, except near the anchorage; the sand and spits had become better defined, and the area of the anchoring ground had increased, with a greater depth of water as far as the bulkhead. No greater depth of water over the outer bar and on the bulkhead was found."

The deep-sea soundings and soundings for temperatures in the Gulf Stream have been prosecuted during the season in this section.

Astronomical, telegraphic, and chronometer observations.—These were under the charge of assistant Sears C. Walker. The scheme as organized was to determine the longitude of Portsmouth, Virginia, by the aid of telegraphic connexion with the Seaton station at Washington city, and from the former to deduce that of Forbes' Point, a station about forty-five miles distant, by the daily transportation of chronometers. In preparation, the chronometers had, for six weeks, been daily compared and rated by transit observations at Washington. Assistant Pourtales and Mr. J. R. Offley conducted the chronometric expedition, comparing night and morning, by coincidence of beats, the chronometers daily exchanged between Portsmouth and Forbes' Point. The former made the transit observations at Forbes' Point, and Mr. J. C. Langton those at the Washington station. Assistant Walker superintended the exchange of clock signals on the Seaton chronograph. The observer at Portsmouth tapped on the break-circuit key every five seconds for one minute, for each chronometer, and the hour and minute thus tapped were noted, the signal being registered by the instruments at Portsmouth, Petersburg, and Washington.

During seven days the success of the observations and exchange of signals had been amply favorable, when their progress was temporarily arrested by prolonged failure of the telegraph line after a storm. The operation was continued as far as the means at our disposal and the other exigencies of the season's service permitted. It is not considered, however, as completed.

Reconnaissance. (sketch D.)—The party and vessel employed in the tertiary triangulation were, for about six weeks, withdrawn from that duty and assigned to the use of Major H. Prince, United States army,

assistant in the coast survey, who made the reconnaissance and accompanying sketch of the sound usually known as "Pamlico." Major Prince refers to good maps, to the usage of the neighborhood, and to the oldest authorities, as condemning this orthography, and gives *Pamplico* as the name which appears to have the weight of authority in its favor.

Describing this sound, Major Prince says: "Its breadth from Roanoke island to Long shoal increases from nine to eighteen miles, and in the rest of its length it has a general breadth of from twenty to thirty miles. The general depth of the channel is from three to four fathoms." He notes the fact mentioned by Williamson, a historian of the State, forty years ago, that lands then planted with corn were covered with water at the beginning of the eighteenth century; and observes that if the same causes, whatever they may be, continue to operate, there will be large tracts of the richest possible soil reclaimed for cultivation along this coast. A growth of small live-oak about Ocracoke, it is remarked, vigilantly preserved, protects the soil from the action of the winds.

The exposure of this sound is such that navigation is often dangerous, and vessels have to put back some distance for refuge. Yet the desired harbors are reported to be numerous and convenient, and, to be useful, require only to be made known.

With reference to Core sound, the supposed changes of which had caused the legislature of the State to request its examination, Major Prince reports that he has carefully compared it with the chart of a survey made by Captain T. J. Lee, United States topographical engineers, in 1837. The result is thus stated: "A few small differences of soundings, (we having no tidal observations,) and some small differences of the course (allowance being made for some dredging, of which I have no account, on Piney Point shoal)—in the main, leave the present channel and that of the chart, as it was fourteen years ago, alike."

The sketch by Major Prince, above referred to, shows the scheme for the main triangulation obtained by his reconnaissance.

Secondary triangulation, (sketch D.)—In the season of eight months, (November to July,) assistant J. J. S. Hassler extended this branch of the work along Currituck sound, from Thoroughfare island to the Virginia line. The area embraced was 73 square miles; 12 stations were occupied, and 11 determined; and 871 angles measured by 5,226 observations. The party had the use of the Coast Survey schooner Vanderbilt.

A secondary triangulation, and the requisite topography connected with it, of the entrance to Cape Fear river, was executed by assistant Charles P. Bolles, aided by Mr. J. W. Gregorie, and the results immediately computed and furnished to the hydrographic party working at the same point. A preliminary base, rather exceeding three miles in length, was measured with a chain upon the beach. (See sketch D, No. 6.) From its extremities nearly every important point in the harbor can be seen, and "the triangles are so disposed as to give double determinations of nearly every point of the second order, and of every point of the third order." The work covers an area of 33 square miles; 8 stations were occupied, and 97 angles, on 17 objects, measured with a six-inch repeating theodolite by Gambey, (C. S. No. 35.) The plane-

table survey connected with it furnished 52 miles of shore line, and included the town of Smithville.

The party of assistant Bolles had already been engaged in section V, and were transferred to this section in June, remaining until the close of September.

Tertiary triangulation, (sketch D.)—A party, under sub-assistant A. S. Wadsworth, aided by Mr. C. T. Jardella, with the Coast Survey schooner Bancroft, was engaged in this triangulation from early in December until late in March. It was then withdrawn for use in reconnaissance, and, after some weeks, again occupied, for a short time, in marking with granite posts the most important stations of the preceding year.

The triangulation extended from Cape Hatteras to Ocracoke inlet, 35 miles along the coast, and covered an area of 97½ square miles; 19 stations were occupied and 77 angles measured, by 450 observations, with a six-inch repeating theodolite of Gambey, (C. S. No. 29.)

Topography, (sketch D.)—Assistant Henry L. Whiting spent a month, with a party and vessel, in a topographical survey of the harbor of Beaufort. His work will, in connexion with other surveys, furnish a complete harbor chart. For the gratification of those specially interested, I annex descriptive extracts from his report. (See Appendix, No. 28.)

The amount of work accomplished may be thus stated: Area, in square miles, 22; extent of shore line, 39 miles; outline of shoals, &c., 15; length of creeks, 18; and of roads, 16 miles.

Assistant Whiting points out the causes which, in his opinion, tend to preserve the interior of this harbor from change, and the same general depth of water on the bar. These will be found in the Appendix, as above referred to; though I am not prepared to endorse the views expressed in reference to currents caused by Cape Lookout.

Hydrography.—(See the several sketches.)—Lieutenant Commanding Richard Wainwright, United States navy, assistant in the coast survey, with the surveying schooner John Y. Mason, was engaged in this section during the latter part of 1850, and from April to June, 1851. The hydrography of Roanoke and Croatan sounds, with the small portion of Albemarle sound remaining from last year, has been completed, and that of Currituck sound carried north, as far as the points marked Woodis and Willet's on the sketch. Thirty-three thousand eight hundred and seventeen soundings were made; 1,066 angles taken; and 496 miles of soundings run; nearly all done in boats.

Lieutenant Wainwright also visited Oregon inlet. He found the breakers extending entirely across the bar. The bulkhead towards Albemarle sound remains unchanged, having about three feet of water at mean tide.

Lieutenant Commanding J. N. Maffitt, United States navy, assistant in the coast survey, with the hydrographic party under his command, (which has been for the most part employed in Section V,) visited this section in December last to complete the hydrography of Beaufort, North Carolina; and has furnished a chart of the bar and harbor. (Sketch D, No. 5.)

The statistics of this supplementary work in Beaufort harbor are as

follows: 53 miles sounded over by 1,289 soundings; 88 angles measured; 36 specimens of the bottom obtained; and three sets of observations were made upon currents.

The same party returned to this section and undertook, in October of this year, the hydrographical reconnaissance of the entrance to the Cape Fear and of New river, North Carolina. The lateness of the season prevents their results from being received in time to be embodied in this report.

Tidal observations have been made at Smithville (Fort Johnson wharf) day and night, since July 1, and five current stations have been occupied.

Lieutenant T. A. Jenkins, United States navy, assistant in the coast survey, commanded another hydrographic party, in the Coast Survey steamer Corwin. His operations have been directed—1st, to the re-examination of Hatteras inlet, to place it on the sheet of Hatteras shoals by the aid of the extended triangulation, and to ascertain whether any important changes had taken place; the results have been already indicated, (see sketch D, No. 3:) 2d, to the deep-sea soundings and soundings for temperatures in the Gulf Stream, (sketch D, No. 4:) 3d, to the survey of Fryingpan shoals and the approaches to the main and New Inlet bars at the mouth of the Cape Fear river, (sketch D, No. 8.)

The statistics of his season's work are as follows:

Area of hydrographic sheet	250 sq. miles.
Number of soundings taken	21,990
Number of angles measured	4,300
Number of lines of soundings run	313
Number of miles of soundings	540
Number of specimens of bottom preserved	46
Number of lines of deep-sea soundings run	2
Number of miles of deep-sea soundings run	125
Number of positions for deep-sea soundings and temperatures in the Gulf Stream	4

The report of Lieutenant Commanding Jenkins on the Fryingpan shoals, and his suggestions in reference to the facilities required for navigation, are of such interest that I extract them in full:

"The Fryingpan shoals—extending from the southeast point of Cape Fear, in almost a SSE. direction from Bald Head light-house to the distance of twenty nautical miles, to ten fathoms water, with an average width of four miles—and the approaches to the main and New Inlet bars at the mouth of the Cape Fear river, have been carefully surveyed, and the sheet is now nearly ready for reduction to the publication scale.

"The pilots and others in the vicinity had little correct knowledge of these dangerous shoals, and the great distance to which they extend from the shore rendered the work one of more than ordinary difficulty.

"The shoalest spot outside of Bird shoal, (near the point of the cape,) has 7, 8, and 9 feet water on it at low water, distant 13 nautical miles from Bald Head light-house, and bearing NNW. from it by compass.

"There is another shoal spot with ten feet water at low tide, 14½

nautical miles from Bald Head light-house, and bearing NNW. ½ W. from it. Two small shoal spots, 16 and 18 miles from light-house, with 16, 17, and 18 feet water on them at low water, bearing SSE. ½ E. to SE. by E. from light-house. The sea breaks on these shoals, except in very calm weather.

"Bald Head light-house bears by compass NW. ¼ N. from the eastern point of the Fryingpan shoals, in 6, 7, and 8 fathoms water; coarse gray sand, broken shells, and pebbles, at the distance of twenty nautical miles.

"Bald Head light-house bears per compass NW. by N. from the southeastern point of the Fryingpan shoals, in 8, 9, and 10 fathoms; fine gray sand and black specks; distant twenty nautical miles.

"Not less than 16 feet water will be found outside of the ten-feet shoal, which bears SSE. ½ E., distant fifteen nautical miles from the Bald Head light-house.

"The bottom is well marked on either side of the shoals. On the west side, and at the southeastern extremity of them, fine gray sand with black specks will be found. On the eastern and northeastern side of them broken shells, coarse sand, pebbles, and occasionally small pieces of coral.

"A line made good, SSE. by compass, from the main bar of Cape Fear, will clear the western edge of the three-fathoms curve of the shoals.

"Vessels bound around the shoals to the eastward from the bar should steer out S. by E. to the distance of sixteen to eighteen miles, in eight to ten fathoms water, when an east course will pass on the outer part of the shoals in three fathoms to seven fathoms water.

"These shoals may be said to be continuous from the point of the cape to ten fathoms water, although at the distance of fourteen nautical miles, Bald Head light-house bearing NNW., there is a channel running SW. by S., and NE. by N., of upwards of a nautical mile in width, through which a depth of three and half to five, six, and seven fathoms water may be carried at low tides; but the shoals on either side, with only seven, eight, and nine feet to the northward, and ten feet to the southward and eastward, and nothing but the compass and lead to guide the navigator, in the absence of a light-vessel or buoys, render it too dangerous to be available.

"Vessels drawing not more than nine and ten feet water can cross the shoals at low water by steering ENE., and WSW., at the distance of three to four nautical miles from the point of Cape Fear; and there is a channel between the distances of five and a half to eight and a half nautical miles, through which vessels drawing ten and a half and eleven feet can pass with perfect safety at low tide; the channel is three nautical miles wide, and with the exception of two or three small spots of ten and a half and eleven feet water, thirteen to fifteen feet will be carried through it; the courses are from NE. to ENE., and SW. to WSW.

"At a point of the shoals (Bald Head light-house distant eleven nautical miles, and bearing N. by W. ¾ W.) there is a channel of two and a half fathoms water, upwards of a nautical mile wide. It is in

length only one-third of a mile across the shoal, running NE. and SW.

"Two large iron buoys, properly marked, placed, and moored with heavy moorings, or with Mitchell's screw, would render this channel one of great value, not only to the local trade of the Cape Fear region, but to the coasting trade in general, along the southern coast.

"Any vessel capable of crossing either bar at the mouth of the Cape Fear river, would find no difficulty in crossing these shoals under ordinary circumstances of weather and sea, when these channels shall have been properly marked out by large buoys, enabling those threatened by bad weather to make a port under almost every condition of weather.

"Too much importance, it is believed, cannot be attached to the subject of marking, as perfectly as may be possible, the channels over these dangerous shoals, for the benefit of the coasting trade, and of furnishing means by which to guide the navigator bound north or south in passing outside of them.

"Two large iron buoys are required to mark the best channel over these shoals for coasters.

"The present light-house at Bald Head (said to have an elevation of one hundred and ten feet above the level of the sea) is inadequate as a seacoast light to the wants of the mariner. It is of comparatively little use now, owing to two causes: its great inferiority in brilliancy and intensity, and its bad location, being three and one-third nautical miles from the point of the cape.

"The outer part of the shoals is twenty nautical miles from the light-house, and seventeen from the pitch of the cape.

"Assuming that the present light can be seen as far as the curvature of the earth will permit, (which is not the case,) from the deck of an ordinary merchant vessel, the range in good weather will be fifteen nautical miles—five nautical miles short of the required range to reach the extremity of the shoals.

"To render a light efficient here, it will be necessary to change the location to a position as near the end of the cape as safety and prudence will permit; give the tower an elevation of not less than one hundred and fifty feet, and place in it a first-order dioptric apparatus, combining all the most recent improvements.

"An elevation of one hundred and fifty feet will give an ordinary range from the deck of a merchant vessel of nineteen to twenty nautical miles, leaving the mariner two or three miles on the safe side of the dangers.

"At present the fleets of vessels passing daily these dangerous shoals have nothing but the lead to guide them around them, while contending with currents, which are to a great extent, if not wholly, influenced in strength and direction by the winds.

"The removal of the present Bald Head light-house would work no disadvantage, as it is too far inland for a seacoast light, especially with its present apparatus; and is of very little, if of any, use in a local point of view.

"Until the present light-tower can be removed to its proper location, and a first-order lens apparatus be procured for it, a large light-vessel

ought to be built and placed in the slue, at the distance of fourteen nautical miles from the present light-house. If this vessel is fitted with proper parabolic reflectors and argand burners, and distinguished in a manner to prevent mistakes, it will contribute greatly to the security of life and property, and enable navigators, bound either north or south by this point, to shorten their passage by running boldly, when now they are compelled to creep along with the lead constantly going."

Light-houses, beacons, buoys, &c.—The providing and placing the bell-beacon and iron-buoy, off Cape Hatteras, having been intrusted, by the Secretary of the Treasury, to the Coast Survey, a contract has been made for them to be delivered in the spring of 1852, the earliest period at which it was deemed safe to place them.

In the Appendix (No. 29) will be found a report upon the subject of lights and buoys for Beaufort harbor, North Carolina; also, in the Appendix, (No. 30,) a report upon the necessity for a light-house on the Upper Jettee, Cape Fear river, North Carolina. In regard to the former, Lieutenant Commanding Maffitt observes, that if the lights and buoys be placed as recommended, vessels will enter the harbor in safety, by day or night, without a pilot.

The suggestions of Lieutenant Commanding Jenkins, United States navy, assistant in the coast survey, in reference to lights and buoys in the vicinity of Hatteras shoals, have just been given in full under the head of hydrography.

SECTION V.—FROM CAPE FEAR TO THE ST. MARY'S RIVER, INCLUDING THE COAST OF THE STATES OF SOUTH CAROLINA AND GEORGIA.—(Sketch E.)

In this section two parties have been in the field engaged in triangulation and two in topography, besides the party employed upon the hydrography. The operations have been as follows:

1. Astronomical observations at Savannah, and the preliminary triangulation of the entrance to Savannah river. (See sketch E, No. 2.)
2. The connexion of Charleston and Savannah for difference of longitude by telegraph.
3. The triangulation of North Edisto river, South Carolina. (Sketch E, No. 3.)
4. Secondary triangulation of St. Helena sound and the South Edisto and Ashepoo rivers, extending from Edisto island on the north to the Hunting islands on the south, coast of South Carolina. (Sketch E, No. 3.)
5. A topographical survey of North Edisto river. (Sketch E, No. 3.)
6. A similar survey of part of Savannah river. (Sketch E, No. 2.)
7. Completion of the hydrography of Charleston bar, approaches, and harbor. (Sketch E.)
8. Hydrographic reconnaissance of Savannah river and bar. (See sketch E, Nos. 4 and 5.)
9. Hydrography of North Edisto bar and river. (Sketch E, No. 7.)
10. Tidal observations day and night at several stations.

A map of Charleston harbor, on a large scale, has been engraved, and will be *published at once.*

A chart of Savannah bar and another of the harbor, with the "Main," "Front" and "Back" rivers, have been furnished to the office, and are engraved and nearly ready for publication. The plate of the chart of Bull's bay, on the coast of South Carolina, northeast of Charleston harbor, is in process of re-engraving. (See sketch E, No. 6.)

The chart of North Edisto river and harbor of refuge is put in hand for engraving, and will be published as early as practicable.

At the request of the Chamber of Commerce of Charleston, and by authority of the Treasury Department, a copy of the Charleston harbor map, on a large scale, has been executed, and will speedily be furnished to that body. (See Appendix, No. 30 *bis*, for correspondence.)

After a fair trial in this section, it has been found expedient to cause the secondary, and in some cases the tertiary, triangulation to precede the primary. The greatest difficulty in the primary work is the preliminary tracing, through woods and swamps, and the cutting. The secondary and tertiary work following the circuitous course of the streams, and availing itself everywhere of continuous natural or artificial openings, affords means of running the primary lines from point to point with approximate accuracy, and of correcting readily any errors which occur in running. In executing this triangulation on and near Edisto island, and along the rivers which intersect it, parts of the base of the primary triangulation, which had been marked in the measurement, have been used, as convenience suggested, for the bases of the secondary work.

The difference of longitude of Charleston and Savannah was determined by telegraph, the line having been kindly placed at our disposal, after business hours, by the president of the company, Elam Alexander, esq. At the Charleston end the observations were made by Professor Lewis R. Gibbes, at his observatory; and at the Savannah end by assistant C. O. Boutelle. This connects the Seaton station at Washington with Savannah, the difference of longitude of Charleston and Washington having been determined in our operations of the previous year.

A full report of the computations of the observations by which the difference of longitude was obtained, between Professor Gibbes' observatory, in Charleston, and the Seaton station, at Washington, has been made by assistant S. C. Walker. The mean result is, Charleston west of Washington 11*m*. 45.27*s*., with a probable error of ± 0.02*s*.

In April last I visited the parties in this section for the inspection of their work, and to arrange the details of instructions to the topographical and hydrographic parties in Savannah river. The work was obviously advancing very satisfactorily, and the difficulties which attended its beginning were giving way before the increased experience of those engaged.

The kindness received from the gentlemen near whose residences the operations of the parties bring them, and the facilities uniformly extended in the execution of the work, in many cases at a considerable sacrifice of personal convenience, are acknowledged by all the parties in their reports. As a public acknowledgment by name might be deemed intrusive, I take this method of returning the best thanks of those employed in this section of the survey.

Astronomical Observations.—The observations for time, latitude, azimuth, and difference of longitude from Charleston, at the Exchange of Savannah, were made by assistant C. O. Boutelle, aided by Lieutenant Joseph S. Totten, United States army, detailed for coast survey service; and during a brief period by Professor E. Yulee. An astronomical clock by Kessels had been converted by Mr. Saxton into a circuit breaker, and was used for the observations of local time and for transmission of telegraphic time signals to Charleston. The transits of sixty-five stars were telegraphed to Charleston, and of fifty-eight were received from thence. They were usually observed on all the twenty-five wires of the diaphragm, and all were recorded on the Morse registering fillet. Two hundred and forty transits of sixty-five stars were observed for local time and deviation. The transit instrument was one of those of forty-five inches focal length, by Troughton & Simms, (C. S. No. 4,) with a diaphragm of twenty-five wires, by Würdeman, of Washington.

The observations for latitude were made with a new zenith telescope by William Würdeman, of Washington, (C. S. No. 5,) which is spoken of in terms of commendation by Mr. Boutelle. Seven hundred and forty-six observations were made on one hundred and twenty-six stars, paired according to Talcott's method. The values of the micrometer and level scales were duly determined, the former by observations on Polaris at elongation, a method first proposed and used by Mr. Boutelle.

The azimuth observations were made, by the kind permission of the mayor of the city, from the cupola of the Exchange. The instrument used was a twelve-inch theodolite by Gambey, (C. S. No. 30.) The results are recommended by Mr. Boutelle for adoption in the secondary triangulation only.

Professor Lewis R. Gibbes has observed at the Charleston observatory during the past year, for the coast survey, 39 moon culminations, and 95 transits of moon culminating stars, and six occultations. In connexion with these, 54 observations have been made, with reversal, on circumpolar stars, and on 130 zenith and equatorial stars, for time and instrumental corrections. In the telegraph operations for longitude, 52 stars were telegraphed on 1,220 wires. The importance of keeping up the observations at various points, so as to be sure of corresponding observations with those on the western coast, for longitude, is very great. It secures a clear night for observing, at some one point, when the positions are scattered over a considerable range of country.

Primary triangulation, and secondary connected with it.—The operations were under the charge of assistant C. O. Boutelle, aided, during part of the season, by Lieutenant Joseph S. Totten, United States army, and during nearly the entire season by J. W. Gregorie, esq. They were commenced by the triangulation of the North Edisto river, (see sketch E, No. 3,) in which nine stations were occupied, and 104 angles measured, on 86 objects, by 785 observations with an eight-inch Gambey theodolite, (C. S. No. 2.) The services of Mr. Boutelle being required at Savannah, this triangulation was completed by Mr. J. W. Gregorie, who retraced and opened several lines, and erected signals for the primary triangulation. In March, Lieutenant Joseph S. Totten made a reconnaissance for the triangulation from the Edisto to the

Stono river, inside of, and parallel to, the sea-beach. The reconnaissance made by Mr. Gregorie up the Dawho to Aiken's station on Jehossee, and along the Wadmelaw river to New Cut, is shown upon the sketch—(sketch E, No. 3.) Mr. Boutelle remarks: "I make it a point to avoid extensive cutting in secondary triangulation, and it is a matter of much difficulty to get triangles of proper form without it. The houses along the river aid us much in carrying out our schemes of triangulation; and I cannot too often express the obligation we are under, for the uniformly friendly and courteous manner in which our requests to be allowed to erect signals and place instruments upon them are complied with."

Two primary stations, viz: the east and west ends of the base, were occupied by Mr. Boutelle for the measurement of horizontal angles, and at one (east end of the base) azimuths were measured. The observations were made with a theodolite by Würdeman, (C. S. No. 30.) It was found absolutely necessary to employ heliotropes in order to obtain a sufficient number of observations without a long delay.

In the entire work, of both classes, executed by this party, from taking the field in December to the close of the season in May, 15 stations were occupied, and 173 angles measured, on 158 objects, by 2,073 observations. This is in addition to the astronomical determination at Savannah, already noticed. The work was continued as long as the means provided for this particular party permitted.

An examination for points of triangulation for the entrance to Savannah river, to be used by the hydrographic party in sounding out Tybee bar, was made by assistant Boutelle in March, and it was intended that he should execute this operation personally; but having been temporarily disabled from work by an accident occurring after his party at Edisto had been discharged, the triangulation was made under his direction by Mr. J. W. Gregorie. The preliminary work intended for immediate use in a hydrographic reconnaissance is shown on sketch E. Twelve stations were occupied, and 218 angles measured, on 33 objects, by 383 observations. The operation was closed on the 3d of June.

The results of the triangulation of North Edisto river were furnished to the topographical party surveying those shores, and those of the Savannah river to the hydrographic party sounding the entrance and harbor.

The great activity of the party under Mr. Boutelle in field-work has involved a corresponding amount of office-work, in which he has, except during brief intervals of field duty which have been elsewhere stated, been laboriously engaged. In these computations he has been assisted by Messrs. G. A. Fairfield and J. R. Offley. Lieutenant J. S. Totten was, on the closing of the field-work in this section, attached to the party of assistant Edmund Blunt in Section III, (Virginia,) and Mr. J. W. Gregorie to that of assistant Bolles in Section IV, (North Carolina.)

Secondary triangulation.—The secondary triangulation executed by assistant Charles P. Bolles is shown in sketch E, No. 3. It rests upon a portion of the base on Edisto island measured for the primary work, and, gradually widening out, covers the South Edisto and Ashepoo rivers, and St. Helena sound, furnishing a very well conditioned scheme of work, and well selected points for the use of a topographical party.

Assistant Bolles commenced this work in February, and closed operations in May; he was assisted in it by sub-assistant George A. Fairfield, and during part of the season by S. S. Pendleton, esq. It was carried on under disadvantageous circumstances from the illness of Mr. Bolles, and yet presents a considerable amount of work. The area embraced is 35 square miles, 12 stations were occupied, and 115 angles measured, on 24 objects, by 978 observations, with a six-inch repeating theodolite by Gambey, (C. S. No. 35.)

Soon after closing this work, the services of assistant Bolles were called for, to execute the secondary triangulation, already referred to, at the entrance to Cape Fear river, North Carolina. He is now under instructions to complete the triangulation of the Savannah river, already commenced, and to carry the work, which has just been described, southward and westward, towards Beaufort, South Carolina.

Topography.—Assistant George D. Wise was engaged, with a plane-table party and the surveying schooner Franklin, upon the topographical survey of North Edisto river and harbor of refuge, South Carolina, from February 12 to April 18, when himself and party were transferred to the seacoast of Virginia. He was aided by J. A. Denny, esq.

Both shores of the river are embraced in this survey, (sketch E, No. 3,) which covers 40 square miles in area, and extends along 100 miles of shore-line and 44 of roads.

The base measured in 1850 on Edisto island furnished marked points, which were made available for the topographical survey.

Sub-assistant S. A. Wainwright, with another party, during the two months ending June 7, was employed in the topographical survey for a harbor chart of Savannah river. His work has established the points used by Lieutenant Commanding Maffitt, United States navy, for the hydrography—from Elba island to Argyle island, on both sides of Hutchinson's island, including eight and a half miles of shore-line; from Elba island to Savannah city, (comprising the wharves,) on the south side of the river; and from Elba island to a little below the south base signal on the north side, (see sketch E, No. 2.)

From this section Mr. Wainwright and party were transferred to work along the eastern shore of Virginia.

Hydrography.—Lieutenant Commanding J. N. Maffitt, United States navy, with the Coast Survey schooner Gallatin, (after being a few days employed in Section IV,) returned to this section December 12, 1850. He resumed the survey of Charleston bar and approaches, and in about one month completed the soundings requisite for the chart of that harbor. Thence he passed to North Edisto inlet, South Carolina, and, after much interruption from boisterous weather, finished, March 5, 1851, the hydrography of that river and bar, (sketch E, No. 7.) In the Appendix (No. 30 *tris*) are sailing directions, which have been published, furnished by Lieutenant Commanding Maffitt, for the entrance into that harbor of refuge. "It is about sixteen miles to the southward and westward of Charleston light-house, and is easy of access, one course over the bar taking the vessel to a safe anchorage. At mean low water there are thirteen feet on the bar. The mean rise and fall is six feet."

The hydrographical reconnaissance of Savannah bar and river was next undertaken; the shore parties co-operating being furnished with

a boat's crew from the vessel. The work, completed June 4, extends from one mile outside of the outer bar buoy, embraces the "Main," "Front," and "Back" rivers, and terminates at Argyle Tree, six miles above the city of Savannah, (sketch E, Nos. 4 and 5.)

The statistics of the work in this section are as follows:

Number of observations of angles	2,069
Number of soundings	60,001
Miles sounded over	1,237
Number of specimens taken of bottom	95
Number of sets of current observations	14

From the Savannah river Lieutenant Commanding Maffitt returned to Section IV; and, after necessary delays for repairs of vessel and shipment of a crew, entered on the reconnaissance of the bars of Smithville and New river, North Carolina.

A permanent tide-gauge was erected at Fort Pulaski, entrance of Savannah river, where careful observations, day and night, of the tides have been regularly made since January.

A permanent tide-gauge has also been erected at Castle Pinkney, in Charleston harbor; but circumstances have not heretofore permitted tidal observations to be made with the same regularity.

At North Edisto inlet the tides were observed, day and night, for eight weeks.

Besides their field-work, Lieutenant Commanding Maffitt and party have completed and turned in the following office-work, in mapping their results, viz:

A chart of Charleston bar and harbor.

Another of the same bar and approaches, with additional work on Rattlesnake shoals, which was off the limits of the original sheet.

A chart of Savannah bar, from one mile outside of the outer bar buoy to Cockspur.

One of Savannah Main river, from Cockspur to Shad's Chimney.

Another of Savannah Front and Back rivers, from Shad's Chimney to Argyle Tree.

A chart of North Edisto bar and river.

Charts of Beaufort, North Carolina, bar and harbor.

Lieutenant Commanding Maffitt renders acknowledgments for the courtesy and facilities extended to him, while employed in Savannah river, by the officers of the army there stationed.

Section VI.—from the St. Mary's river to St. Joseph's bay, coast of Florida, and including the Florida reef and keys.—(Sketch F.)

The work on this important and comparatively ill-known portion of our coast has been pushed vigorously, as far as the appropriation permitted, in all its branches. The land parties have had in use three vessels belonging to the coast survey, or hired for the purposes of transportation; and the hydrographic party the Coast Survey steamer Hetzel, which had been put in thorough repair after the accident of last year at Cape Canaveral. Four parties have thus been in the field, engaged on the main and secondary triangulations, the hydrography and

topography of those keys and reefs where the need of information was most urgent.

It should be remembered that the appropriation recommended by the Treasury Department in 1848–49 for the speedy survey of this section, was reduced from $100,000 to $30,000, and that the present limited scale of work merely provides for the ordinary rate of progress. Even as it is, however, the knowledge acquired and now ready for publication will be of no small value towards the saving of life and property, so often lost or perilled on this coast. The habors of Key West and Cedar Keys, the passage of the Boca Grande, and many of the smaller keys and reefs, have been thoroughly examined and mapped; mistakes of charts in present use rectified; and determinations made for the sites of lights and buoys indispensable to the safety of navigation. Accompanying this report are—the general sketch F, showing the progress of work in this section; sketch F, No. 2, showing on a larger scale the progress of Cedar Keys, Dry Tortugas, Key West, Bahia Honda, and Key Biscayne; sketch F, No. 5, of the harbor of Key West and its approaches; sketch F, No. 4, of the harbor of Cedar Keys, with Suwannee bay to the northward and westward, and Wacassassa bay and the harbor and offing of Crystal river to the southward and eastward; and sketch F, No. 3, of Mosquito harbor.

The new channel at Key West, mentioned in my last annual report as indicated by the work for that season, has been found to afford a depth of 26 feet.

The depth that can be carried through the passage of Boca Grande is ascertained to be 13 feet. Into Cedar Keys bay it is found that, by the main channel under Sea-horse key, 12 feet can be brought in, and, perhaps, under favorable circumstances, 14.

Examination has confirmed the vaguely reported existence, off Crystal river and below Cedar Keys, of a harbor and anchorage (in the bay now called St. Martin's, just south of the Withlacoochee river) into which 12 feet, and, under favorable circumstances, 14 feet of water may be carried; and which will be valuable not only as a shipping port for the produce of several neighboring rivers, but as a place of refuge for coasting vessels.

It may be remarked, as a matter of general interest, that the survey indicates Way key as the most desirable and, indeed, the only suitable terminus for the railroad across the peninsula. The anchorage at Crystal river being at some distance from the main land, renders that point ineligible; besides, that the route would be over rivers and marshes to reach it.

Professor Agassiz has lent the aid of his distinguished talents in an examination, the results of which are embodied in a report discussing the topography of Florida, its reef, keys, coral reefs (living and dead,) ship-channel, main land, coast, and the physical changes in the Gulf Stream. Apart from the fact that this report would be too much extended by including that document, its importance requires that I should make it the subject of a special communication.

This examination was imperiously called for by the contradictory statements in regard to the character of the reef in its different portions, being by some represented as composed of living and growing coral—

by others of boulder masses of dead coral; sustaining, in the two cases, altogether a different relation to navigation, and to the questions of sites for light-houses and sea-marks. The very interesting question of the past growth of the Florida reefs and the formation of the present peninsula of Florida, and of the keys which form such remarkable appendages to it, has been fully solved by Professor Agassiz, who has also shown what may be expected in the future; and, establishing the fact that the existence of the coral depends upon the depth of the sea, proves that no reef is to be expected exterior to the one existing.

This, of course, supposes that no change occurs in the relative level of the land and water; and here, again, the labors of Professor Agassiz have been in the highest degree valuable, by establishing that no *general* change of this kind is going on in that part of the coast; the phenomena of growth of the reef, formation of the keys and of the main land, being explicable without such supposition. I have extracted such portions of the report of Professor Agassiz as bear most immediately upon the subjects of my present report, in the Appendix No. 10; but the whole work is too valuable to permit any portion to be lost, and I therefore respectfully recommend that it be presented to Congress by the department in a separate report.

Hourly observations of the tides near Key West have been made under my instructions, and the immediate direction of Lieutenant Commanding John Rodgers, United States navy. They have been plotted, and are in course of reduction and discussion, in the same manner as those at Cat island, Louisiana. The results are of great interest in reference to the general subject of tides in the Gulf of Mexico; but the investigation is, perhaps, in its present stage, too purely technical to make an extended notice desirable in this report. There are two high and two low tides daily at Key West; the successive tides being nearly equal about the time of the moon's passing the equator, and there being at other periods one smaller and one larger tide in the course of the twenty-four hours. This diurnal inequality is a very remarkable feature, and can already be approximately calculated.

The work of this section will be resumed as early as arrangements can be made for the ensuing season.

Reconnaissance, triangulation, &c.—Assistant F. H. Gerdes has been occupied (with the exception of a brief absence on duty in Section VIII) from November 1st, 1850, to June 20th, of this year—first, in reconnaissances, having for their object to select stations for the main triangulation, and to connect the Tortugas with the main body of the work; second, in preparing, clearing and grading a base line on Key Biscayne, and another at Cape Sable; third, in the establishment of stations, main and secondary, and in the triangulation.

The description of the coast and other information conveyed in Mr. Gerdes' report of a reconnaissance, which extended from Suwannee river to St. Martin's reef, are of so much interest that I annex the report nearly entire. (See Appendix, No. 31, and sketches F, Nos. 1 and 4.)

Mr. Gerdes has found that, by fixing a signal upon Rebecca shoal, about midway between the Tortugas and the Marquesas, the former group may be brought into connexion with the general scheme of main

triangulation. This plan involves less time and expense than those previously suggested, and dispenses with the use of reflecting instruments and of floating signals. A short base must be measured on the Tortugas, and an astronomical station for azimuth observations be made there. In that group, the triangulation from the Logger-Head base will furnish a proper side of nearly five miles, and a distance of four miles may be had at the Marquesas from the eastern triangulation.

The base lines, referred to in my last annual report, have been cleared with some labor, levelled, and well prepared for measurement. (See sketches F No. 3, and F No. 4, report of 1850.)

In the triangulation of this season 30 signals have been put up, and determined from 11 stations, forming 41 triangles, and embracing the whole of the harbor, with all four channels of the Cedar keys, and the islands themselves. A small preliminary base of about two miles was measured on Way key by chaining, and the ends, as well as all the stations of the triangulation, secured by posts. Six of the primary stations have been marked by stone monuments. The area covered by the triangulation exceeds 40 square miles; 96 angles were observed, usually by six repetitions direct and six reversed, sometimes by more frequent repetition.

Assistant Gerdes and party have also carried on their office-work—computation of results—during the season.

Secondary triangulation of keys and reef.—This part of the work was conducted by assistant J. E. Hilgard from December 20, 1850, to February 1, 1851, and from that time up to June 3d, (when the season was at an end,) by assistant L. F. Pourtales. The field of operations embraced Boca Chica, Key West, and the Marquesas, during the former portion of the season; and during the latter, Key Biscayne bay, including Soldier key, Ragged keys, Elliott's key, and Rubicon Point, with the main land from Shoal Point (twenty-five and a half miles, by the shore-line, southward from the mouth of the Miami river) to Turkey Point. (See sketches F No. 1 and F No. 2.) Mr. Hilgard gives the following statistics of his work: 9 stations occupied; 18 ditto observed upon; 100 angles, each the mean of six repetitions, observed (with the eight-inch Gambey theodolite, C. S. No. 24;) area of the work, 78 square miles. Mr. Pourtales reports 3 stations occupied; 18 points observed upon; 497 sets of measures of angles made; area of work, 70 square miles.

His comparatively small progress is accounted for by difficulties occasioned by the prevailing trade-winds, and by the uncertainty often arising from lateral refraction—the lines passing over shoal water, which rendered it necessary to repeat the observations frequently.

Much time has been occupied and great difficulties encountered, necessarily, in the erection of signals. Where it is necessary to insert them in the rock of the reefs the patent screw-pile of Mitchell has not yet been successfully applied; but it is hoped that, before the next season for observation, the object will have been accomplished by the addition of a heavy capstan-head applied to the screw-pile, and a tripod to steady it.

Should this apparatus not prove effective, the object may be attained, as suggested by Mr. Pourtales, by a modified application of an arrange-

ment already used by Major Bache, of the United States topographical engineers, consisting of an iron disk sunk into a bed, and having a socket in which to fasten a signal-pole.

Lieutenant James Totten, United States army, joined this party in the latter part of the season, with a view to qualify himself to take charge of its operations during the next.

Topography.—During the first five months of the current year, a party, under charge of assistant Hull Adams, assisted by Mr. R. M. Bache, was engaged in the survey of the keys and shore-line indicated in the accompanying sketch F, No. 2.

Sheet No. 4 contains Man key, Woman key, Mule key, Boca Grande, and the Marquesas.

This latter group embraces 9 distinct keys, has an area of 12 square miles, and a shore-line of 30 miles.

Sheet No. 5 contains Bahia Honda and seventeen smaller keys.

Sheet No. 6 contains Key Biscayne, Virginia key, and 25½ miles of the shore of the main land, from the mouth of Miami river southward to Shoal Point. It may be useful to mention two points on this shore where excellent fresh water can be procured: one, the "Punch Bowl," is about two miles, and the other, called "the Hunting Grounds," about twelve miles, below the mouth of Miami river.

The whole extent of shore-line included in the season's work is 139 miles, and the amount of area 186 square miles. Boca Grande, Woman key, and Virginia key, were surveyed by Mr. R. M. Bache.

The character of these keys is so little known that it may be well to quote the general description given by Mr. Adams:

"There is very little variety in the character of the topography of the keys surveyed during the past season. They are generally covered with a thick growth of mangrove, which extends quite to the water's edge. On the parts of the keys towards the reef, however, there is sometimes a good beach; but the entire inner side is of mangrove, with a very deep, thick mud along the edge. Upon the southern and eastern sides of the Marquesas there is a very good beach, which extends for about six miles, interrupted only by one inlet, of one hundred and fifty metres breadth. Key Biscayne has a fine wide beach on the eastern side, nearly four miles in length, of Atlantic sand, which is quite different from the shells and ground coral (Gulf sand) of the other keys. On the western side there is a very high growth of mangroves, and the character of the mud seems to be much the same as that about the other keys. This mangrove thicket extends nearly half across the island, for two-thirds of its entire length. The other part is covered with a thick palmetto scrub. The shore of the main land, commencing at Miami river, has a sort of hammock growth of about a quarter of a mile in width for three miles; after which, for about five miles, there is a prairie growth which extends back to the commencement of the pines. This pine land extends, in many places, to the everglades. For the next four miles the hammocks increase in width, interspersed with swamps and prairie grass. A narrow ledge of rocks, about ten feet in height and covered with trees, is a distinguishing feature of the first three or four miles below the mouth of the Miami river."

Hydrography.—The hydrographic operations were delayed by circum-

stances beyond my control, and were not commenced until January. Lieutenant John Rodgers, United States navy, assistant in the coast survey, has been in charge of the party, and commanding the Coast Survey steamer Hetzel, employed in the work.

The minute survey, now completed, of the harbor and approaches of Key West, has determined the valuable result, that safe passage for vessels of any class into that port may be permanently indicated. As remarked by Lieutenant Rodgers, the difficulties of approach for large vessels would at first appear insuperable. He points out positions in which a vessel may have three fathoms on one side, and six on the other—may run over a point with seventeen feet water on it, and have thirty-six feet by both leads. The profile view (sketch F, No. 5) is furnished by him to illustrate this extreme irregularity of the coral formation.

The drawing of the entire chart of Key West (see sketch F, No. 5) is furnished for publication, and its engraving has been commenced.

The general depth on the *spots* in the harbor varies from ten to twenty feet, and is, in their immediate vicinity, from twenty-five to thirty-six feet. Lieutenant Rodgers estimates that a safe channel for the largest ships may be marked out at an expense of about $2,000, by *fixed* buoys, to be secured with heavy chains and Mitchell's mooring-screws; and observes that shifting buoys would be worse than useless—a snare. The value of this harbor is well urged by him, as follows:

"All the ocean-commerce of the valley of the Mississippi keeps within a few miles of Key West. The harbor is important as a place of refuge and repair, and this value grows with the commerce of the West.

"In time of war with a maritime power, its importance will be greatly enhanced, and its waters will be white with every class of sail, either seeking protection under its guns, or lying in wait for an enemy."

The important passage of Boca Grande (from the Gulf of Florida into the Gulf of Mexico, used when the winds are light and the Gulf Stream current strong) has been surveyed, and the chart is nearly completed. It has been ascertained that thirteen feet can be carried over the bar.

A survey has been made of Mosquito harbor, which will be further mentioned in its proper connexion, (see sketch F, No. 3.) For a brief account of the inlet, its past condition, and recent changes, see Appendix No. 32, containing extracts from Lieutenant Commanding Rodgers' report. Soundings were attempted across the Gulf Stream, from Key West to Havana, but unfortunately arrested by the loss of the line; and in returning from Havana, the new method of sounding with twine could not be tried on account of bad weather. The experiments, however, were not without interest. Lieutenant Rodgers states: "We then ran thirty minutes S. S. W. by compass, or three miles from the last position, and in the same place (except drift) the following casts were taken:

370 fathoms,	no bottom,	white wax on	end of lead	untouched.
408 "	"	"	"	"
760 "	"	"	"	"
2,977 "	"	(apparently.)		

"In reeling up, the line parted 245 fathoms from the surface of the water.

"At 2,977 fathoms, I thought that the lead had not reached bottom, because I could perceive no abatement in the velocity of the line running through Burt's patent sounding nipper. Whether the lead did reach bottom at that depth would have been shown by the wax arming upon regaining the lead; unfortunately it was not regained.

"After leaving Sand key, the vessel was, by astronomical observations, first set to the westward of her course, and afterwards to the eastward of it. The lead-line seemed not to partake of this drift, since the vessel was first set to the westward of the line; and to the eastward of it when the current farther from the shore had become easterly. These facts lead me to the inference (which the difference of the temperature shown between the surface water and the deep-sea soundings may seem to corroborate) that the current does not run at such great depths as the lead reached."

For the season, from January 4 to June 17, 1851, the work of the steamer and boats amounted to 2,492 miles of soundings, for which there were 95,332 casts made of the lead, and 4,120 angles measured for position.

Pending the delay in the arrival of the vessel assigned to Professor Agassiz for transportation, Lieutenant Commanding Rodgers afforded his aid and the use of the steamer Hetzel, for the exploration (before mentioned) conducted by that gentleman.

Light-houses, buoys, &c.—Assistant Gerdes' examination (Appendix No. 31) has confirmed the suggestion of Lieutenant Commanding James Alden, United States navy, reported last year, that Sea-horse key is the only suitable site for a light-house, which was appropriated for by the last Congress, to be placed somewhere in the approach of Cedar Keys. It should be placed at a sufficient elevation (for which a spot elevated 45½ feet is designated by Mr. Gerdes) to show over the whole Sea-horse reef. That reef has been found to extend in reality about fifteen miles, although its length has hitherto been laid down on the charts as about seven.

Mr. Gerdes adds: "There ought to be a buoy placed on the point of this reef, by all means. In foggy weather the Sea-horse (key) is invisible from thence, and the reef is very difficult to distinguish, as the water outside deepens only gradually, and retains the same color. A screw-pile, (disk-screw,) with a barrel, could be inserted easily, the reef being only of quicksand, and a sort of coral sand."

Lieutenant Commanding John Rodgers, United States navy, assistant in the coast survey, has surveyed the Mosquito inlet with reference to the placing of buoys. For his report see Appendix No. 33, and sketch F, No. 3. In the same report he discusses the subject of communication between the local pilot and the vessel, in weather when boats cannot cross the bar. Local conventional systems of signals have been adopted for this purpose in some places, but it is highly desirable that a uniform method should be adopted by authority, for all the barred harbors of the United States; such a plan forms part of his report, and it is respectfully commended for consideration, (see Appendix No. 33.)

Assistant Gerdes recommends very strongly—and his recommendation

is concurred in by Lieutenant Commanding Rodgers—that a lighted beacon or a light-house be placed on Rebecca shoal, between the Marquesas and Tortugas. The passage in which this shoal or reef lies is a thoroughfare for vessels bound to ports in the Gulf of Mexico; the shoals are therefore dangerous, and at present are not marked. For the letters of Lieutenant Commanding Rodgers and Mr. Gerdes on this subject, see Appendix No. 34.

SECTION VIII.—FROM MOBILE POINT TO VERMILION BAY, INCLUDING THE COAST OF ALABAMA, MISSISSIPPI, AND PART OF LOUISIANA.—(Sketch H.)

The operations of this section have been on the same general scale as hitherto, the greater proportion of the means being, however, devoted to the hydrography, which is proportionably less advanced than the other parts of the work. One secondary triangulation party and one topographical party have been employed in extending the work westward, over Mississippi sound and Lake Borgne; and a hydrographic party, having an efficient steam-vessel (the Coast Survey steamer Walker) and other facilities, have been occupied in off-shore work south of Dauphin and Petit Bois islands, and in-shore work north of the same islands, and in special examinations of Pass Christian harbor and the mouths of the Mississippi.

The secondary triangulation of the previous year was necessarily in part repeated, and a new connexion made with the primary work; which, with the character of the season, has rendered the progress less than was expected. The triangulation of the Bay of Biloxi and of St. Louis bay was completed. The topography has well advanced to include both sides of Pass Christian.

A steam-launch, constructed by Mr. J. G. Young, engineer United States navy, under the immediate direction of Lieutenant Commanding Jas. Alden, for in-shore and harbor work in this section, was unfortunately lost in a storm off the Chandeleur islands in May, so that the party had but little aid from her services.

The discussion of the tidal observations at Cat island has been continued under my immediate direction, and the results deduced have been found of considerable interest in a practical and scientific point of view. Persons who had longest observed these tides believed that they were without regularity, and navigators generally who had attended to them, supposed that they resulted from the action of the wind. I have shown, on the contrary, that the results are strictly referable to law, and do not depend upon the wind, except as a modifying cause. The first results deduced are given in a paper presented, by authority of the Treasury Department, to the American Association for the Advancement of Science, at their meeting in August, 1850, which, with some revision, is transferred to the Appendix No. 7. It is not a little curious that a case of the single-day tides, to which these belong, (having, as a general rule, but one high and one low water in the twenty-four hours) should be among the earliest on record, having been examined by Newton in his original discussion of the tides in connexion with the theory of gravitation. The phenomenon met no further development until recently

observed in the tides of the eastern coast of Asia, and in the higher regions of the northwest coast of America, by the Rev. W. Whewell, who was the first successfully to trace its laws from observation. The small rise and fall of the water in the Gulf of Mexico, renders exact and continual observations necessary to ascertain the facts. Such observations have now been obtained at the two localities of Cat island and Fort Morgan, and will be followed, in due course, by observations at a sufficient number of points to trace the tides of the Gulf. (See sketch H, Nos. 2 to 6.)

A more considerable portion of the means available for this section than in preceding years has necessarily been devoted during the past year, and must be applied in succeeding ones, to the preparation of the results for publication. The computations have been kept up; the reduced drawings of Mobile bay (two sheets) have been in progress; the engraving of the entrance sheet of Mobile bay has been completed and published, and that of one of the sheets of the inner bay has been commenced. The lower sheet of the bay will form part of the general coast sheet, extending over Mississippi sound, westward.

At the request of parties interested, an examination was commenced of Milneburg harbor, on Lake Pontchartrain, the terminus of the railroad from New Orleans. Assistant S. A. Gilbert, after closing his triangulation in this section, visited the spot, and has furnished the data requisite for undertaking its hydrography; but, owing to unavoidable circumstances, this information was not received by the officer in charge of the hydrographic operations, until too late for him to begin the survey that season. Lieutenant Commanding Sands, United States navy, is under instructions to execute it during the ensuing season.

Sketches of the reconnaissance of Pass Christian harbor, and of the mouths of the Mississippi, (Pass à l'Outre and the Northeast and Southeast Passes.) accompany this report.

The first-named examination was made at the request of the citizens interested in Pass Christian. That town occupies a somewhat important relation to New Orleans as a healthy summer residence for families; and it is represented that intercourse is rendered difficult, and the mails delayed, by frequent grounding of the steamers upon the shoals. (See sketch H, No. 9.)

By the reconnaissance of the Mississippi delta, (sketch H, No. 8,) an interesting comparison is furnished with the survey made by Captain Andrew Talcott, corps of engineers United States army, in 1839, showing that the marshes have generally been extending further out to seaward; that the channel has deepened at the Pass à l'Outre, and become shoaler at the Northeast and Southeast Passes.

The judicious recommendations of Lieutenant C. P. Patterson, United States navy, in regard to beacons and buoys upon this coast, which he had made a matter of special study, and in respect to which his views were seconded by his successor, still remain unacted upon, as at the date of my last annual report. To what is already contained in that report I can add nothing but a respectfully renewed invitation of attention to the subject. Should the scheme there suggested appear of too much magnitude to be embraced in the appropriations of a single year, it may at least be commenced, and gradually and systematically carried

out to completion, so that partial benefits shall be realized in proportion to its progress. The commerce of Mobile bay, and of the harbors of Cat and Ship islands, has great need of such facilities for navigation. (See Appendix, Nos. 35 and 36.)

For the determination of differences of longitude by methods described in my last annual report, I have had in view the establishment of a station for telegraphic connexion between New Orleans and Washington, by the line of the coast or by a line passing through Cincinnati and the valley of the Mississippi. Assistant Gilbert recommends Fort Wood or Fort Pike as suitable and convenient points for the purpose of connecting with the coast line of telegraph, being included in the scheme of triangulation, and within a few hundred yards of the telegraphic wires from New Orleans to Mobile.

Triangulation, (sketch H.)—This portion of the work was under charge of assistant Samuel A. Gilbert, who was supplied with a small vessel for transportation, and was aided, during the latter part of the season, by Mr. Charles M. Bache. The party was engaged for five months, ending May 20th—first, in the triangulation of Biloxi bay; second, in connecting that series with the main scheme to the eastward; third, in the repetition of observations of the previous year in St. Louis bay, unsatisfactory through defect of the instrument; and finally, in the extension of the secondary triangulation westward over Mississippi sound and Lake Borgne to the eastern shores of Lake Pontchartrain. Mr. Gilbert's summary of results is as follows:

"The area covered by the triangulation of Biloxi bay is 48 square miles. The area covered by the work necessary to the connexion with the main series, and previously covered by it, is 40 square miles. The area covered by the triangles remeasured is 96 square miles—being in all 184 square miles.

"The area covered by the triangulation as yet unobserved, but of which all the signals have been erected, is 608 square miles. The number of angles measured is 67, for the determination of which 94 series of 12 repetitions each, and 8 of 6 repetitions each, or 1,176 angles, were observed."

The experience of the party indicates the months of May and June as more favorable for observing, in this region, than the three months preceding.

Assistant F. H. Gerdes made a brief visit to this section, which was employed in erecting permanent marks at the main stations.

Topography, (sketch H.)—Assistant W. E. Greenwell was engaged in this duty, aided by Mr. W. M. Johnson, and having the use of the Coast Survey schooner Phœnix. The resulting work is indicated by the accompanying sketch, which embraces (in three sheets, marked 18, 19, and 17, respectively) Pass Christian and its vicinity, the Bay of Biloxi, and coast eastward as far as West Pascagoula river. Upon the general topography of these sections, Mr. Greenwell's remarks may be quoted as interesting:

"The character of the country embraced in sheet No. 17, or the one running from West Pascagoula river to Biloxi bay, is similar in every respect to that described in previous reports—the shores being low and smooth, thickly wooded to the very water with pine, principally, inter-

spersed with magnolia and hammocks of live-oak. Skirting the shore along is here and there a settlement, with small spots of cultivated ground, whilst the interior, for miles and miles back, is but a dense forest of pine, apparently in its wild and primitive state.

"The character of the topography upon sheet No. 18 is very similar to the one just described. The town of Pass Christian, situated upon a ridge of fast land, about twenty feet above high water, sloping gradually towards the sound and again back in the interior, presents the only feature different from sheet 17. Around it is the same wild, thick forest of pine as seen along the whole coast.

"The features of the country embraced in the Biloxi sheet are somewhat different from that just described. On the east shore of Biloxi bay the banks are abrupt, being from twenty-five to thirty feet in height, and of a red clayish soil. Here, too, unlike the other parts of the coast, the shores are quite thickly settled, and improvements have been made, and are still making, which, in a few years, will make it a place of some importance.

"Along the shores of the 'Back bay,' and on the banks of the bayous emptying into it, are at present, in successful operation, many mills, foundries, &c. From these and other resources a trade between Biloxi and New Orleans is kept up, amounting to about $390,000 per annum, keeping in constant employment about eighty or ninety vessels, amounting in all to about three thousand five hundred tons."

During the season of five months (December to June) the area surveyed was 65 square miles; the length of shore-line 227, of roads 27, and of streets and wharves 15 miles.

Hydrography, (sketch H, Nos. 7 to 10.)—The party under charge of Lieutenant Commanding James Alden, United States navy, assistant in the coast survey, was engaged in the survey of Bon Secours bay until its completion, when that officer was transferred to another section. The operations were conducted during the remainder and greater portion of the season by Lieutenant Commanding B. F. Sands, United States navy, assistant in the coast survey. The steamer Walker was appropriated for the use of this party.

The work off the entrance of Mobile bay was extended off-shore, both eastward and westward, (south of Dauphin and Petit Bois islands,) to the distance of eight or ten miles. Pass Christian, in Mississippi sound, was, in compliance with a special request of the residents, closely sounded from Henderson's Point to near Pitcher Point, and three and a half miles from shore. It is thus described by Lieutenant Commanding Sands:

"A depth of seven feet can be brought into the channel from the west by keeping the west beacons open to the southward, passing to the southward of the first beacon and northward of the second. At the eastern beacons it is rather shoaler; 6.3 feet can be taken in, with the inner beacon open to the eastward of the new church steeple until nearly up with that beacon, and thence to the steamboat wharf. The bottom being soft and the current strong, I should suppose a mud-machine could, at comparatively little expense, deepen the channel at the east and west beacons sufficiently for steamboat navigation."

A reconnaissance was also made, by the same officer, of the Missis-

sippi delta, to which I have already referred as showing considerable change. "The marshes have made out seaward, mud-lumps have been washed away, and others formed." From his report I quote the following useful advice for entering the Mississippi river:

"On account of the frequent changes on the bars, no sure sailing-directions can be given for crossing at any of the passes. Vessels should not approach the shore nearer than the depth of ten fathoms without a pilot, as it shoals up from that depth rapidly; and at night, after seeing the light at Northeast Pass, they should heave to or anchor outside of ten fathoms until daylight, when the pilots and tow-boats come out.

"The tow-boats generally anchor inside of the entrance, and in fair weather cruise off from ten to fifteen miles. Vessels are rarely delayed for want of tow-boats, as there is considerable competition, and they keep a good lookout for the offing."

The progress effected this season is shown in sketch H, of which the sheet marked No. 11 indicates the work of Lieutenant Commanding Alden, the remaining sheets that of Lieutenant Commanding Sands—the former embracing 95 square miles of area, 223 miles of soundings, and 13,760 casts of the lead; the latter, 275 square miles of area, 688 miles of soundings, and 28,244 casts of the lead. The time employed was from January 16 to June 10, 1851.

From the results furnished by the hydrographic surveys, sailing-directions for Horn Island pass were made out and communicated to parties interested. (See Appendix, No. 37, and sketch H, No. 7.)

Section IX.—from vermilion bay to the boundary, including the coast of part of louisiana and texas.—(Sketch I.)

The work in this section has been conducted on the scale of previous years, three parties being in the field. Its progress is represented on the general sketch I. The triangulation has been carried from the vicinity of Galveston as far westward as the Brazos river, and all the primary and secondary station-points secured by permanent marks. An attempt to extend the secondary work into East bay failed, from insufficient depth of water, no means of land transportation being accessible. The topography of the bays about Galveston has been completed, as also the hydrography of the harbor, entrance, and approaches. The chart of Galveston entrance is in course of reduction for publication, and its engraving is provided for. A hydrographic reconnaissance and delineation of Aransas Pass and minute examinations of sites for light-houses in Galveston bay will be reported under their proper head. The rapid and extensive changes of the Aransas bar will appear worthy of special notice.

Peculiar difficulties are opposed to the work by the climate and topography of this region, which disturb the atmosphere so as to destroy its transparency; and which have induced the recommendation by assistant Williams of a diminished length of sides for the triangles. The obstacle of the belts of timber on and about the Brazos, which proved somewhat in the way of the triangulation, is supposed to be the only feature of the kind on the coast of Texas, from the Sabine to the Rio Grande.

Hourly observations of tides have been instituted, and will be kept up by observers stationed at Galveston. These tides are observed and discussed on the same plan as those of Cat island and Mobile bay, in 1848 and 1850–51, and as at present at Key West—forming part of a system for ascertaining the tidal phenomena of the Gulf of Mexico.

Triangulation, (see sketch I.) Assistant James S. Williams has been in charge of this portion of the work, aided by sub-assistant Spencer C. McCorkle, who was for the most part separately engaged in reconnaissance and observations for the secondary and tertiary triangulation. The Coast Survey schooner Belle was in the service of the party.

The main triangulation has been connected, from the newly occupied primary stations, Chocolate and Hall's bayou, with that of the previous season. In extending the scheme westward from the new station Peninsula, assistant Williams was encountered by the serious, and, on this coast, exceptional obstacle, of heavy belts of timber on the Brazos river, Oyster creek, and Bastrop bayou. He has, however, so selected the points Jupiter and Hamilton, that the line from the Peninsula to the former, although striking the villages of Velasco and Quintana, passes along a street, and the lines from Hamilton to the other two points pass through openings in the timber.

In observing over the long lines of sight of the main triangles, great obstacles are encountered, which Mr. Williams thus enumerates: "The climate of this region, unless the last season is an exception to its general character, is singularly unfavorable for extended geodetic operations. The stormy winter, the short twilight, and intense heat of cloudless summer; the frequent, almost constant, high winds; the hazy, misty air,—all battle against progress; indeed, the air may be said to be clear only during a norther, when it is impossible to make an instrument steady on its high tripod."

In one case, twenty-three days were occupied in endeavoring to effect measurements that in a favorable atmosphere would have required but a few hours. Mr. Williams recommends contracting the sides of the main triangles, that more results may be obtained in proportion to the time.

The secondary and tertiary triangulation has substantially advanced as far as the Brazos river. The contraction of the side between Oyster creek and Rattlesnake secondary stations, somewhat marring the symmetry of the general scheme, was a judicious measure of economy to avoid cutting through heavy timber. Some time was lost in an unsuccessful attempt, before mentioned, to extend the work into East bay, in the other direction.

In reference to the preservation of stations, assistant Williams reports: "The primary points that have been occupied during the season are each marked by an earthenware cone, buried three and a half feet below the surface; upon this a wooden piece, one foot square, rests, and supports a granite block, two feet long and ten inches square, marked with a cross upon its middle point. Besides this, three smaller granite blocks are sunk to within three inches of their upper surface—north, south, and east from the centre, and three feet distant. The secondary

points are marked by the cone in the centre, and the three blocks disposed, as above, around it."

In this season, from December 10, 1850, to June 10, 1851, 8 stations have been occupied, of which 3 were primary, and 5 secondary; 58 angles measured from 2,484 observations; 15 signals have been put up, giving 163 square miles in area of primary, and 99 square miles of secondary triangles. The instrument used by assistant Williams was C. S. theodolite No. 31.

Assistant Williams, in his report of a reconnaissance for triangulation, remarks upon the unusual topography of a portion of the coast, as follows: "I have found along the Brazos river and Oyster creek (which run nearly parallel for twenty miles from the Gulf) belts of heavy timber, principally live-oak, coming down to within five miles of the gulf, and varying in breadth from one to three miles. Crossing Oyster creek at a point about fifteen miles from the gulf, and proceeding eastward, I found heavy live-oak timber on the head of Bastrop bayou."

Topography.—The party of sub-assistant J. M. Wampler was in the field during the first five months of 1851, and had in use the Coast Survey schooner Nymph. Its duties were made arduous by an inclement season, and by the necessity of often working at stations covered with water.

The results of the work are comprised in a complete topographical map of Galveston bay, (see sketch I, No. 2,) of which about one-third had been accomplished the previous season. The amount of work may be reckoned as follows: shore-line surveyed, 281 miles; area of country, 188½ square miles; and 25 miles of roads. It includes West bay, East bay, and Bolivar peninsula, Turtle bay, and the delta of Trinity river.

Hydrography.—Lieutenant Commanding T. A. Craven, United States navy, assistant in the coast survey, was in charge of the party, and of the Coast Survey schooner Morris, engaged in this work. He has made a survey (see sketch I, No. 2) of Galveston harbor and its approaches. Sheet No. 1 comprises the harbor, and sheet No. 2 the bar and approaches.

During the season, from March 19 to June 29, the lines of soundings amounted to 484 miles; the number of soundings being 31,100, and the area surveyed 55 square miles. The soundings were made in depths of from one foot to eight fathoms. 1,665 observations of angles were made.

The depth of water on Galveston bar is stated to be twelve feet.

Lieutenant Commanding Craven has also made a special examination of Clopper's bar, Red Fish bar, and Half Moon shoal, in Galveston bay; and of Aransas Pass, the entrance used for Corpus Christi as well as Aransas bay. All of these (see sketches I No. 2, and I No. 3) will be referred to in their proper connexion. I may quote here, however, Lieutenant Craven's mention of the remarkable changes about Aransas Pass, (sketch I, No. 3,) as follows:

"The point in my reconnaissance designated as '*Old Range*,' was, in 1846, *within* 120 *yards of the channel*, and the 'Range' itself was *awash*. It is now 350 metres from the beach, and upwards of half a

mile from the mid-channel. The 'capstan' was planted in 1849, for heaving off a vessel which had grounded in this channel.

"The point I have marked as '*E. Range*' was formerly a Pilot's Range, and fifteen months since was about fifty yards from the beach in the channel way; it is now 340 metres from the beach.

"You will see from the above, that the point of St. Joseph has, for five years, been working rapidly out to the southward, and as it encroaches on the channel, the opposite point of Mustang island wears away with equal rapidity. All of the point of St. Joseph, from the '*Old Range*' to the spit at the Narrows, is a loose, sandy flat, which has been entirely formed since 1846, and on which vegetation has commenced. I found an unusual depth of water on the bar, nine and a half to ten feet, which may be accounted for by the strong and continued southeast winds of this season; ordinarily there are from seven to eight feet."

A temporary tidal station was established in connexion with the soundings about Galveston, and observations made additional to those at the regular station, which has been left in charge of an observer. The latter station was transferred from Bolivar Point, for greater convenience, to the city of Galveston.

Light-houses, buoys, &c.—Appropriations were made at the recent session of Congress for light-houses in Galveston bay, and preliminary surveys have been required for their location.

My report upon the subject, and that of Lieutenant Commanding Craven, who surveyed the sites proposed, will be found in Appendix No. 38.

I have recommended the erection of three light-houses, namely: on Clopper's bar, Red Fish bar, and Half Moon shoal—the two latter conditional upon the approval of some competent engineer, doubts being expressed by Lieutenant Commanding Craven as to the stability of the foundation. (See sketch I, No. 2, and sub-sketches.) That officer suggests, also, the necessity of a buoy off Dollar Point.

The reconnaissance of Aransas Pass indicates such frequent and rapid shifting of the bar and beach, that no light-house can be suitably placed with a prospect of permanence. The report of Lieutenant Commanding Craven (Appendix No. 39, and sketch I, No. 3,) giving details of the harbor and its changes, recommends a small light-vessel and buoys on the bar. In the same connexion, objections are strongly urged against the present location of the light-vessel at Galveston.

Sections X and XI.—the coast of California and Oregon.—(Sketch I.)

In my last annual report, showing the progress of the work in California and Oregon up to October, 1850, the future course proposed for the survey of the western coast was stated as follows: "To determine the geographical positions of the prominent points, correcting existing charts by them and by intermediate reconnaissances, and using them as points in the final survey; to make such surveys of harbors and anchorages, of sounds, of bays, and of portions of the coast, as may be most immediately useful, taking up first the parts necessary for the

establishment of light-houses, beacons, buoys, and other aids to naviga tion, using the methods of the Coast Survey, and establishing such permanent marks as will enable us to bring together these detached parts into a complete survey of the coast; to publish the successive approximations which we make, so that, whenever we have better materials than those already existing for charts, they may be given to the navigator, without waiting for the best results which we can produce. In this spirit, the reconnaissance of the coast now preparing for publication will be followed by a similar one south from Monterey; the sites for the light-houses provided for in California, now under examination, will be reported upon; the preliminary survey of Columbia river entrance, now reducing, will be published, and the examination carried up the river to Fort Vancouver, and up the Willamette; the portions of San Francisco bay, the surveys of which are required by the Engineer department and for light-house purposes, will be first taken up, to be followed by a complete survey of that and of the adjacent bays, after less known portions of the coast have been embraced in the work."

In accordance with the principles thus laid down the survey has been prosecuted, upon a scale increasing as new appropriations became available, and with all the energy to be expected from the meritorious officers engaged in it. Although it was late in this season before the operations could be disembarrassed of difficulties growing out of the want of funds and the peculiar circumstances of the country, yet the beneficial effects of a more liberal expenditure are beginning to be realized; and I feel justified in pointing to the results, as a worthy and valuable contribution towards the knowledge of our Pacific coast and the safety of its navigation. If those results are not fully equal to our expectation, they have fallen short only through causes defying the control of man—I allude to the lamented death of him from whom we had received most, and from whom we hoped so much more; the wreck and necessary abandonment (on the coast of Patagonia) of our steamer; and the serious injury and detention of our sailing vessel south of San Francisco—disasters which have combined to leave our hydrography, especially, behind our hopes and just anticipations.

Before proceeding to an account of the work, I feel that a pause is due to honor the memory of him who was its able and ardent pioneer, and whose name must hereafter be identified with the western coast as its most distinguished and useful explorer—Lieutenant Commanding Wm. P. McArthur, United States navy, assistant in the coast survey.

The tribute paid by his associates to his memory seems to deserve a place in the records of the government and the work which he so faithfully served and honored; it is accordingly annexed in Appendix No. 40.

I proceed to present the state of the work. It will be remembered that, up to the date of my last annual report, our operations had furnished: 1st, a general sketch of the coast from Monterey to the Columbia river, with hydrographic notices, including detailed descriptions of principal entrances, and with a table of approximate longitudes and latitudes; 2d, a preliminary survey of the Columbia river, from its entrance to a point above Astoria; 3d, a survey of Mare Island straits, in the bay of San Pablo, interior to that of San Francisco; and 4th, reports

upon light-houses for the bay of San Francisco, for Cape Disappointment, at the entrance of the Columbia river, and for New Dungeness and Cape Flattery, in Oregon.

Since then, the leading objects in our plan of operations have been the exact determination of the position of prominent points, and the surveys necessary for the establishment of lights and channel-marks most important to the present wants of navigation. The astronomical and topographical parties, and, as far as practicable, those engaged in triangulation and hydrography, have combined upon the same localities to effect the rapid completion of the purposes in view; and the two former parties have been for the most part left together, for convenience of co-operation and economy of transportation. The triangulation party has united with its normal scheme not only the surveys requisite for the location of light-houses, but those of a general character called for by the joint commission intrusted with the selection of sites for military and naval establishments. The hydrographic party, crippled in its operations by causes already cited, and which will be more fully dwelt upon, has lent its aid to the others, and of late has been occupied in important independent examinations; among which the continuance of the general reconnaissance to the southward of Monterey ranks first, and will be pushed as rapidly as practicable. I proceed to state briefly, reserving details for their proper place, the general results of the season, which are:

1. The exact determination (for which see Appendix No. 41 *bis*) of Point Conception, the Hatteras of the western coast, and its survey for the location of a light-house. The latitude was computed from astronomical observations made at that point; the longitude, from the comparison of observations there of moon culminations with others made on the Atlantic coast. The magnetic variation was also determined. The topography exhibits the proper site for the light-house authorized by Congress, and embraces several miles of the neighboring shore.

2. Similar observations to fix the geographical position of Point Pinos, at the entrance of Monterey; and a similar survey, indicating the best situation for a light-house. (See Appendix No 42.)

3. The astronomical observations made for determination of Punta Loma, in the bay of San Diego. The triangulation and topography of that bay, covering all that portion of it available for commerce; and so much of the hydrography as is necessary for the entrance, and with reference to location of a light-house. Also sailing directions for approach and entrance of the harbor; and a light-house report. (See Appendix No. 43.)

The topography embraces all that will be needed, after completion of the hydrography, for a harbor chart.

The triangulation extends from the False bay, on the north, to the Mexican line, on the south—thus connecting the coast survey work with the "initial point" of the boundary survey, established by Major Emory, United States topographical engineers. A sketch of the islands called "Los Coronados" has also been furnished, giving their approximate position.

4. Observations at the entrance of Columbia river for the position of Cape Disappointment, with a topographical survey of the cape, and a

report for the location of a light-house, by law provided for, on that point. (See Appendix No. 44.)

The fogs prevalent upon this coast interpose a serious obstacle to observations for latitude, and to those for moon culminations; but the ordinary transit observations for time are more easily attained; and, to make these available, a chronometer expedition, between San Francisco and the mouth of Columbia river, has been organized, and is in progress, for the determination of longitude. Its results are not yet reported.

The topographical party has also extended its labors over Point Adams, on the opposite shore of the Columbia and its vicinity; and the hydrographical party has furnished views (eye-sketches) of the entrance and approaches of Columbia river, representing the features of the coast. Ten iron can-buoys were shipped in January, 1851, and the remaining two in February, to be delivered to the collector of customs at Astoria, Oregon. They have been received, and are to be placed under the direction of the coast survey party in the vicinity.

5. Preliminary surveys of Humboldt Harbor and Trinidad bay, the former believed to be, in point of excellence, the *third* harbor on that coast, easy of access, and having twenty-one feet on the bar at low water; the latter is reported as affording a good harbor of refuge, and, during half the year, a safe and convenient anchorage. A site for a light-house, provided for by law, to be placed at the first of these bays, has been examined and reported upon. (See Appendix Nos. 57 and 57 *bis*.)

6. Surveys in and about the bay of San Francisco, by combined triangulation and topographical parties, preliminary to the general triangulation, and yet immediately directed to light-house and defensive purposes. These embrace:

A minute survey of Fort Point, at the entrance, and Alcatraz island, inside the bay; proposed sites for light-houses, (see Appendix No. 46.) The survey of the southern shore of the bay, founded on a measured base, and covering the ground pointed out by the joint commission for examination with reference to fortification. A reconnaissance of the Farallones (islands) for rectification of their position. A survey of Mare island, united with that of Mare island straits, and extended over the Straits of Carquines. This survey furnishes all the topography needed for the information of the joint commission, with a view to the location at Mare island of a navy yard. Approximate determinations of latitude and longitude have been made on the southern shore of the bay.

The more exact geodetic and hydrographic operations of the survey have been deferred in this harbor, (though their application at an early period is contemplated,) not through an under-estimate of its ultimate importance, but because existing charts yield better approximate knowledge of this than of other principal portions of the coast. It has therefore been estimated that the same amount of labor would yield greater and more immediately beneficial results even to the commerce of San Francisco itself, if dispersed through other fields, than if concentrated there. The charts of Captain Beechy, British navy, those of Captain Wilkes, of the United States Exploring Expedition, and, more recently,

those published by Captain Ringgold, United States navy, leave far less to be desired for this than for other leading points.

7. To the above general account of operations it is to be added that the hydrographic operations have recently been directed to some revision of the general coast reconnaissance between San Francisco and Monterey; the extension of that reconnaissance from Monterey southward has been entered upon; and the survey of the bay of Monterey has been already executed.

Having received, during the last year, two interesting reports from Lieutenant W. A. Bartlett, United States navy, assistant in the coast survey, referring respectively to the general character of the coast of California and to the commerce of Columbia river, I have embodied those reports in the Appendix, (Nos. 48 and 49.)

Astronomical and magnetic observations.—Assistant George Davidson is in charge of these. At the date of my last annual report he was engaged at Point Conception, by far the most dangerous, and therefore the most important point, in reference to coast navigation. His observations were for latitude, for longitude by the method of moon culminations, and for magnetic variation and dip. The results have been computed and published.

From that point (after unavoidable delays arising from untoward circumstances, especially the injury of the schooner Ewing in a gale, which compelled the return of the party to San Francisco) assistant Davidson proceeded to establish an observatory near Monterey, in connexion with the survey for a light-house site—from thence to San Diego, and finally to Cape Disappointment, mouth of Columbia river; pursuing the same system of observations at each as at Point Conception. The last advices left him at Cape Disappointment, whence he proposed to pass successively to the determination of Capes Orford and Mendocino, the two most prominent points between the Columbia river and San Francisco.

As soon as the advance of winter renders it necessary to leave the field in Oregon, assistant Davidson proposes to establish stations at points along the coast, and determine their differences of longitude by transit observations, in connexion with transportation of chronometers. The success of this scheme would add San Pedro, Santa Barbara, Trinidad and Humboldt bays to our list of points exactly determined.

Assistant Davidson is aided by Mr. John Rockwell.

Triangulation, &c., (sketch I, No. 9.)—Assistant R. D. Cutts was assigned to this section to take charge of a double party for combined purposes of triangulation and topography. The circumstances of the work pointed to his selection as peculiarly fitted for the superintendence of mixed operations, versed as he is by experience in every branch of the duties of the coast survey. His operations were specially directed to the examinations requisite for light-houses, and to those asked for by the joint commission on military and naval establishments, (for correspondence in relation to which, see Appendix No. 3, in my report of 1850.) The general surveys for the purpose last mentioned have been accomplished. The results for the season have furnished—

1st. The survey of Alcatraz island and Fort Point, and a report on them as sites for light-houses. (Sketch I, No. 6, and Appendix No. 46.)

2d. The topography of the southern shore (including the island of Yerba Buena) of the bay of San Francisco, from the vicinity of the city to that of Point Lobos at the entrance—including the contemplated sites for fortifications—founded on a base measured on the beach of San José. (Sketch I, Nos. 6 and 9.)

3d. An examination of the Farallones for approximate determination and rectification of their position, (Sketch I, No. 6,) and Sailing Directions, (Appendix No. 47.)

4th. A survey of Mare island, its straits, the entrance and part of the Straits of Carquines, affording all the topography necessary for proposed establishment of a navy yard at Mare island. (Sketch I, No. 2.)

5th. Topography of the northern shore of the bay of San Francisco, (sketch I, Nos. 6 and 9,) from Saucelito to Point Boneta.

6th. The triangulation (for which a preliminary base was measured) of the bay of San Diego, from False bay to the Mexican territory. "The southernmost signal is on the boundary line, and about forty feet westward of the marble monument marking the initial point." Combined with the topography of sub-assistant Harrison, this furnishes a map of the bay, for which see sketch I, No. 7.

Augustus S. Rodgers, esq., was the aid of assistant Cutts, and was specially employed on the topography.

The statistics of the season's work show: 2 preliminary bases measured, 68 signals erected, 37 stations occupied, 170 angles determined by 4,688 observations, 4 stations whose altitudes were determined by spirit-level, 20 stations whose altitudes were trigonometrically determined, 228 vertical angles measured, and 188 observations for azimuth.

Topography.—Sub-assistant A. M. Harrison was at the head of the topographical party longest in the field. For brevity's sake, I refrain from a recapitulation of his movements, which have been so far identical with those of the astronomical party, except that, at the last advices, he had passed to the topography of Point Adams, and the southern shore of Columbia river. Mr. Harrison's operations, as already stated, have been mainly directed to the surveys necessary for location of light-houses. His results are embodied in—first, a sketch of Point Conception and its vicinity, for several miles of shore-line, and a light-house report, (see sketch I, No. 3, and my report, Appendix No. 41;) second, a sketch of Point Pinos and shore-line of vicinity for several miles, and a light-house report for the entrance to Monterey, (see sketch I, No. 4, and Appendix No. 42;) third, a topographical map (sketch I, No. 7) of the bay of San Diego, including Punta Loma, proposed as the site for a light-house, and La Playa, the port of San Diego, accompanied by a report descriptive of the bay, (Appendix No. 50,) and a report upon the location of a light-house, (Appendix No. 43;) fourth, the topography of Cape Disappointment, and three miles of the shore at the entrance of Columbia river, (sketch I, No. 10,) and a report in reference to the erection of a light-house at that point, (Appendix No. 44,) also the topography of Point Adams the opposite cape.

For local information and description, I refer to these reports.

The topographical operations of the party under assistant Cutts are so bound up in execution, and in results, with those of the triangula-

tion, that, to avoid tedious repetition, I have described them under that head.

Hydrography.—Up to the date of my last annual report, the late Lieutenant Commanding Wm. P. McArthur, United States navy, assistant in the coast survey, was in charge, but survived a short time only. He was succeeded, December, 1850, in the command of the Coast Survey schooner Ewing, by acting master J. H. Moore, United States navy, who was relieved, May, 1851, by Lieutenant Commanding James Alden, United States navy, assistant in the coast survey. During this period, the Ewing was severely injured in a gale, and for some time under repair.

Lieutenant Commanding Alden, delayed by the difficulty of shipping hands at the then prices of California, which far transcend all Atlantic ideas, set out, about the middle of June, for a preliminary survey, which occupied about two months, of Humboldt and Trinidad bays. For his maps, see sketch I, Nos. 8 and 5. His general description of the character of those bays, I quote as follows:

"Trinidad bay is a very convenient and safe anchorage during six months in the year, and will be found, by vessels that have suffered from the strong head (northerly) winds that prevail along this coast, a comfortable harbor of refuge. Humboldt bay is, I think, the third harbor on this coast; it is sixteen miles long, and from three-quarters to four or five miles wide; the entrance between the breakers is nearly straight, but rather along the coast; it is about a mile long, and two hundred metres wide between the eighteen-feet curves on either side, with twenty-one feet at low water on the bar. It is perfectly accessible except in very heavy weather, when the sea breaks entirely across the entrance."

More detailed information upon these harbors, and that of San Diego, and sailing directions for the latter, have been published, and will be found in the Appendix, (Nos. 45 and 50.)

The hydrography of the entrance and part of the bay of San Diego is given on the harbor map (sketch I, No. 7) already referred to under the head of topography.

Lieutenant Commanding Alden reports it as highly necessary to the safety of navigation in the harbor of San Francisco, that buoys should be placed on the Invincible and Blossom (sunken) rocks; and the expenditure is accordingly recommended. (For correspondence on the subject see Appendix No. 52.)

An examination has been made of the bay of Monterey, which is reported as completed, although the results have not yet been received. The schooner Ewing was detached for this duty.

Lieutenant Commanding Alden, in the steamer Quickstep, temporarily chartered for the purposes of the coast survey, has been engaged in a re-examination of the coast between San Francisco and Monterey; after concluding which, he has entered upon a continuance of the general coast reconnaissance from Monterey to our southern boundary. He will also prosecute, during this winter, the hydrography of the bay of San Francisco.

The draughtsman, Mr. McMurtrie, of the hydrographic party, de-

tached for the purpose, has furnished drawings (eye-sketches) of the entrance to Columbia river and of the neighboring coast.

The projected hydrographic operations in Oregon having been prevented by the loss of the steamer Jefferson, it is proposed to print the map of Columbia river entrance, and to send copies to the hydrographic party on the western coast, to be corrected there if the changes in the south channel are found to be of importance, and then to be published. Sailing directions for entering that river will be found in the Appendix, No. 51.

It is my painful duty to record the death of Passed Midshipman William De Koven, United States navy, an officer of high character, who had been but a short time attached to the coast survey. The letter of his commander, reporting his decease, is given in Appendix No. 53.

For the judicious execution of the hydrography on this coast a steam-vessel is essential. Hence the loss of the steamer Jefferson is severely felt. That vessel was so strained and dismantled by a gale off the coast of Patagonia, (proverbial for the severity of its storms,) that although, by God's mercy and by the well-directed exertions of her commander and crew, she was enabled to reach Port Desire in safety, it was necessary to abandon her there, since, even if repairs had been practicable, no facilities were accessible. In the Appendix (No. 54) will be found a report of the circumstances, and evidence that the vessel had been, after proper examination, approved as sea-worthy; had been properly fitted and provided; was commanded and worked with all the judgment and energy suitable to the occasion; and was finally abandoned through inevitable necessity. Her disastrous fate seems to be one of those cases in which the power of the elements defies all the efforts of human art and skill.

Lieutenant Commanding F. K. Murray, United States navy, was the commander of the Jefferson, and, before abandoning her, made satisfactory arrangements for saving and bringing home her boilers and machinery.

I take pleasure in quoting from a letter of Lieutenant Commanding Murray the following mention of the zealous and disinterested assistance afforded to himself, his officers and crew, by a stranger—the recital of whose conduct will insure him the admiration of every generous mind:

"It gives me pleasure to mention to you the noble conduct towards us of Mr. Henry Powell, the proprietor of the guano settlement—the generous sympathy, hospitality and friendly aid he extended to us during our protracted stay upon the coast of Patagonia. We soon became entirely dependent upon him for provisions, and these were furnished with his characteristic liberality. For many of them he would receive nothing; and for those furnished the government, charged nothing beyond the prices paid for them by himself. He scorned to take advantage of our necessities, and put himself and men upon short allowance that we might not want. This gentleman, endeared to all on board the Jefferson by his kindness, as well as by his social worth, is a native of Ireland."

The steamer Corwin has been built for the coast survey out of the appropriation for the western coast; but the Jefferson was sent in her

place to save time, and the Corwin retained for the eastern coast. It will now be necessary to send the latter to replace the lost vessel in the Pacific, and the Treasury Department has directed her to be fitted out. Her withdrawal will be a serious loss to the eastern hydrography, and the interests of that work will require her to be replaced.

OFFICE WORK.

Every department of the office has, under the able supervision of Brevet Major I. I. Stevens, of the corps of engineers, continued to improve, and has filled the full measure required by the increasing number, amount, and variety of results returned by the field-work of the coast. For the first time every section under survey has reached that step when results are steadily returned and require provision for publication.

The progress of the work has rendered practicable arrangements for prompt publication, which, when it was less developed and executed on a smaller scale, were not possible. It is due to Major Stevens to acknowledge the promptness which is secured in the publication of results, and the maturing of a system by which sketches and preliminary charts are made in every case to precede the more finished work, furnishing valuable results to the navigator as soon as obtained by the surveyor.

The rapid execution of the engraved charts of the western coast reconnaissance is a proof of the perfection of this organization and of the zeal of those who administer it. Three well-executed sheets of reconnaissance were engraved and ready for publication within twenty working days after the beginning of the engraving. Preparations of a similar kind have been made to execute the charts of the southern portion of the same coast as soon as received, so that publications may be furnished early in the new year. The present report contains no less than three charts and thirty preliminary sketches, of immediate utility to navigators—the result generally of the work of the past surveying year.

It is, of course, understood that these latter do not pretend to be finished charts, but simply what their titles indicate—sketches, to be filled up and perfected as the work advances.

The divisions of the office-work are as follows: 1. Computing; 2. Drawing; 3. Engraving; 4. Electrotyping; 5. Printing; 6. Publishing, distribution, and sale; 7. Instrument making; 8. Archives and library.

The computing, drawing, engraving, and instrument making are each under the charge of an assistant, immediately responsible to the assistant in charge of the office, and directing, under his supervision, the details of each branch; the general direction, as a branch of the entire work, resting with the superintendent.

Major Stevens acknowledges, in his report, in complimentary terms, the services of assistant Hilgard, in charge of the computing department; of Lieutenant Richard H. Rush, United States army, in charge of the drawing department; of Joseph Saxton, esq., in charge of the instrument making; and of Lieutenant E. B. Hunt, of the corps of engineers, as his general assistant, now temporarily in charge of the en-

graving. Lieutenant A. A. Gibson, United States army, is also referred to in terms of warm commendation, for valuable assistance in the miscellaneous duties of the office.

The general result is thus referred to in Major Stevens' annual report: "It gives me pleasure to report that during the past year there has been a visible improvement of the office in all its branches, and it is my pleasure and duty to bear unqualified testimony to the zeal and efficiency of the several assistants in charge of the departments, and of the numerous employés under them. Each man has shown an honest purpose to do his duty; and I have been much oftener obliged to moderate exertion, than to rebuke indifference and neglect. These latter cases have been rare; and I speak advisedly when I say, I know of no person in the office, from assistant to laborer, who is not attentive and faithful in the discharge of his duties.

"It is fortunate that such has been the case; for the duties of the office have increased more rapidly than suitable assistance could be procured. Work for the first time has been devolved upon every branch of the office from each section of the survey; and the amount of work has not been small, growing out of a class of duties that was, by Congress, at its last session, assigned to the survey in connexion with the location of lights. No less than twelve engraved plates have resulted, the present year, from this entirely new class of duties; a fact in itself significant both of the amount of duty and the efficiency of the survey, both in the field and office.

"To Samuel Hein, esq., the general disbursing agent, I am under obligations for advice both in general and in special matters, which he is so well qualified to give from his great familiarity with the past history and the present condition of the work, and from his entire devotion to its best interests."

The records of the computing department have been systematized and the registers improved during the past year. The list of geographical positions, 3,240 in number, prepared for publication in a preliminary shape, is the best evidence of the zeal and ability of the gentlemen engaged in this part of the work. In the hydrographic portion of the work, reports have been made on the condition of the observations; the best methods of keeping, registering, and arranging them; and on the condition of the reductions; and have formed the basis of action in these matters.

The subject of current charts has been studied, and many tidal reductions have been made.

The arrangements in the drawing department have been improved by judicious arrangements and distribution of the duties, more in accordance with the special talent of the draughtsmen, in the division of the work, in the application of the system of contract, or of remuneration proportioned to the time of working, to such parts of it as admit of these arrangements. The condition of the department is represented by Major Stevens as very efficient, and the exertions of all employed in it are commended.

"Great exertions have been required to increase the force in this important department, (engraving,) and to classify their duties to meet the requirements of the survey.

"There are now eighteen engravers—five employed on a salary, one on a *per diem*, nine on contract, and three apprentices. Much of the work can best be done by contract; all the lettering and figures, views, sands, swamps, and even hills. Only one letterer is now employed on a salary; and to him is assigned the most difficult work, as titles and general lettering.

"The contract system has generally given satisfaction." Major Stevens speaks favorably of the improvement made by the younger members of this department, and of the zeal and fidelity of all.

It is due to the efficiency of the drawing and engraving departments that nearly the whole work of the past year is presented in sketches, with this report, to Congress. Major Stevens observes: "Our arrangements now are such that the work, as fast as it comes in, can be given to the public in preliminary sketches. Its effect will be great, both as an incentive to parties in the field, who see at once the fruits of their labor, and to the office force, in affording a better opportunity to train the younger members and prepare them for the finished charts. These sketches will, in most cases, be the finished charts, simply by the addition of the ornamental work.

"So the system of preliminary sketches and finished charts will actually hasten the publication of the latter, besides being the best system to apply, men having different degrees of skill; all, however, gradually rising to the highest excellence.

"The electrotyping department has improved so greatly the past year in all its arrangements and processes, that at my request its chief, Mr. Mathiot, has made a general report on the subject of electrotyping, (Appendix No. 55,) which I respectfully commend to your consideration.

"The advances which have been made through the agency of the Coast Survey have scarcely been equalled in the history of any art. Not a single failure has yet occurred in Mr. Mathiot's process. A single plate has again been reproduced from the junction of plates with complete success.

"The time for reproducing a plate has been greatly abridged. Time has been saved, and a greater certainty given to the process, by a heating apparatus, which is described in Mr. Mathiot's paper, and which is exhibited on the sketch accompanying his report. The work of this department the past year is not to be estimated by the number of plates made—16, all that were required by the wants of the survey—but by the great improvements that have been introduced—improvements necessary to meet the wants of the department the ensuing year. The sale of maps will, undoubtedly, soon be greatly extended.

"The time has come to call into action agencies for special sale of Coast Survey maps. They should be carried to each man's door having an interest in commerce, navigation, geography, and science. Mr. Mathiot can with certainty, in the present state of the art, reproduce his first basso in eight, and every subsequent basso in four days. These times may be reduced to six and three days. A plate has actually been made the past year, and returned to the engraving department, in sixty-five hours from the time the alto was sent to the electrotyping rooms. Certainly in fifty days the plates can be made for 15,000 sheets of any Coast Survey map, however large and elaborate

it may be: this shows the great practical utility of the process in the operations of the coast survey.

"Many of the plates will require three to four years' work of an engraver, and will cost from three to six thousand dollars. By the electrotyping process we can reproduce them in eight days, and at a comparatively trifling expense of some two hundred dollars."

A hydraulic press for map printing, intended to remedy the distortion which is now unavoidably produced, in a greater or less degree, by the copper-plate printing press, has been devised by Mr. Saxton, and is now in the course of construction under his direction.

The results obtained in the instrument shop, both in reference to the quality and economy, are very encouraging.

The arrangement of the archives has been much improved during the past year, in reference to registering, to completeness of detail in them when returned, and to facility of reference. Major Stevens again calls attention to the necessity for improved accommodations for the office of the survey. He remarks: "I again beg leave to call your attention not only to the pressing necessity of more extended accommodations for the safe-keeping of the archives, and for a probable increase in the business of electrotyping, printing, publishing, and sales, but to the unfitness of the present quarters for the purposes of drawing and engraving.

"I would recommend a suitable building as calculated to give a better tone to the whole establishment; making supervision more effective, giving better facilities for the furtherance of work, and abridging many expenses in the way of heating the rooms, and of repairs and attendance."

The following is a detailed account of the work done in the several branches, according to each of the officers engaged the credit for the results which he has forwarded:

1. Computing.—The computing department has been under the charge of assistant J. E. Hilgard. Under his direction, the computations have kept up with the field-work sent to the office; the final reduction of the work of former years has made some progress; and the preparation of astronomical and geodetic results for publication has been brought to a state of forwardness. In Mr. Hilgard's absence his place has been ably supplied by Charles N. Schott, esq.

Mr. Hilgard, in his report, states that, "the project of work prepared at the beginning of the past year has been adhered to as nearly as circumstances would permit. The experience of the past will enable me to present a project for the ensuing year more definite in its provisions, and covering more fully the ground to be occupied."

Eugene Nulty, esq., has made the second computation of the latitude observations at Soper's, Hill's, and Webb's stations, Section III; with the zenith telescope, at east base Edisto island, Section V; at Point Conception and Point Pinos, Section X, with the zenith telescope; at Agamenticus, Section I, with the prime vertical transit; and azimuth observations at Breach inlet, Section V.

Assistant Th. W. Werner has computed the secondary triangulation of assistant Boutelle, in Massachusetts and Maine, 1850; the secondary triangulation of assistant Farley on the seacoast of Maryland and

Virginia, 1850; that of assistant Hilgard near Key West, 1851; and that of assistant Cutts in San Diego, 1851. He has also made the second computation of the latitude of Seaton station; has reduced prime vertical transits, observed at Nantucket, from 1846 to 1849; and has computed the azimuth observations at San Diego. Mr. Werner, having suffered from sickness and domestic affliction, has not been quite equal to the computations of the current geodetic work, some of which were made in the office.

Charles N. Schott, esq., has been chiefly engaged in the final reduction of the work of former years; and in the revision of latitude computations. He has reduced, by the method of least squares, the horizontal angles at thirty-four stations of the main triangulation in Sections II and III, and established the conditional equations of that work to 1850. He has verified and in part recomputed the computations of latitude at Seaton station, Point Conception, Soper's, Hill's, and Mount Independence. He has computed the azimuths observed at Soper's and Hill's stations, Section III; the secondary triangulation south of Cape Hatteras, 1851; and the latitude observations at San Diego. He has also prepared a report on terrestrial refraction, and has made some computations of magnetic observations. Mr. Schott has also devoted much time and rendered much valuable assistance in matters pertaining to hydrography, which will be referred to under its appropriate head. He has great aptitude for scientific investigation, whether pertaining to astronomical, magnetic, geodetic or hydrographical subjects, and his zeal and industry are fully equal to his ability.

Dr. G. Rumpff has been engaged in completing and perfecting the register of geographical positions, and preparing them for publication. He has also made a preliminary reduction of the primary triangulation, Section I, from 1846 to 1850; and the reduction of the conditional equation of the primary triangulation in Section III, north of Kent island base; has made the second computations of the triangulation of the Salem harbor; of assistant Williams' triangulations in Texas, 1851; of azimuth observations at Marriott's, Section III; and of latitude observations at Nantucket, in 1845 and 1846; and has revised the computations of the latitude of Shellbank, Section IV, and east base, Section V. Mr. Rumpff, throughout the year, has shown his customary diligence and exactness as a computer.

Mr. H. Ginder reported at the office in June, and has been chiefly engaged on computations of verification and adjustment, required in the preparation of geographical positions for publication. He is now (November) relieved from duty in the computing department, and assigned to the party of Mr. Gerdes, as aid.

Mr. M. H. Ober has made miscellaneous computations, under the immediate direction of Mr. Hilgard; and has computed the latitude of Nantucket from zenith distances, observed from 1846 to 1849. Mr. Ober has suffered from ill health during the greater portion of the year.

Mr. Keber has been on duty in the computing department since the 15th of October, and has made himself generally useful.

Mr. Fornaro also rendered service for a short period in the conversion of metre distances into yards and miles for the list of geographical positions.

Mr. Main joined the computing department on the 1st of November and from his high testimonials and the evidence of ability he has already shown, gives promise of future usefulness.

Mr. Hoover, one of the *élèves* of the Survey, has been employed in assisting Mr. Hilgard in the records, and in the simple computation, and has given entire satisfaction in the discharge of his duty.

The whole number of pages copied since November, 1850, is about 10,000, by an average of three copyists.

Hydrography.—Mr. Schott has devoted a considerable portion of his time to making reports and computations in connexion with the hydrography. Besides preparing several tide-tables for the published charts, he has made elaborate reports on the following subjects: on a thorough examination of the hydrographic work in the archives, including tides, currents, soundings, diagrams, and their registering, reducing, duplicating, arranging and binding; on directions for observing and reducing tides; on tides and currents in Hell Gate, and on the coast of New York and New Jersey; and on a method of representing currents. Besides the above, a number of reports on hydrographic matters, of less importance, have been sent in.

Lieutenants A. S. Baldwin and Wm. B. Whiting, and Passed Midshipman S. Nicholson, United States navy, and sub-assistant A. S. Wadsworth, and Mr. Jardella, have also been employed in tidal reductions.

2. Drawing.—Since the 25th March, 1851, Lieutenant R. H. Rush, United States army, and assistant in the coast survey, has been in the permanent charge of this department. Lieutenant A. A. Gibson, United States army, and assistant in the coast survey, assigned to the duty of taking views for the published charts, has prepared the sketches for the list of geographical positions for Sections I, II, and III, brought up the back work on the diagram maps of Sections I, IV, and VIII, drawn the sketches accompanying the report on electrotyping, prepared titles, and arranged notes for the engraving department, and otherwise rendered important service in the drawing department.

Assistant W. M. C. Fairfax was occupied from the 1st of November, 1850, to the end of January, 1851, in the charge of the engraving department. Since then he has rendered invaluable assistance in the examination and elucidation of difficulties in the reduction of maps and charts. He has executed two sheets of topographical specimens, made a new scale of shades, and a partial report on the subject of lettering, all for the use of the office. He has also executed the principal work of the progress maps.

Assistant M. J. McClery continued in charge of the drawing department up to the 25th March, 1851, since which time he has been engaged principally upon the reduction of Chesapeake bay, No. 11, scale $\frac{1}{80000}$. He has also been engaged upon maps showing the progress of the survey, in the verification of drawing, and in other miscellaneous matters.

Assistants Fairfax and McClery are especially commended for their great skill and intelligence, and for their conscientious and rigid discharge of duty. They are exemplars, both as artists and as men, in the department.

Mr. Welsh has been engaged nearly the whole time in the reduction

of Boston harbor, scale $\frac{1}{40000}$, which is now finished. He has also executed a part of the topography of Charleston harbor; made additions to the map of Long Island sound, and several excellent tracings.

Mr. Mahon was occupied upon the reduction of the topography of Mobile bay No. II, which he finished in June. Since then he has been at work upon the reduction of the topography of Salem harbor.

Mr. Luce has finished the topography of Albemarle sound, scale $\frac{1}{80000}$, and has executed the principal part of the hydrography. He has also made various right-line drawings, tracings, projections, and sketches for the annual report.

Mr. Ricketts has been engaged upon the hydrography of Mobile bay Nos. I and II, (No. II being finished,) hydrography of Key West, scale $\frac{1}{30000}$, and has finished the hydrography of the harbors of Huntingdon, Black Rock, Captain's island, East and West, Hart and City islands, Cawkin's island, and Sheffield island; has reduced the hydrography of the vicinity of the city of Savannah, and made an entirely new reduction of Nantucket shoals, and much other miscellaneous hydrography.

Mr. Boschke has completed the topography of Key West, scale $\frac{1}{50000}$, mouth of Columbia river, scale $\frac{1}{40000}$ and $\frac{1}{20000}$, and has made many projects, projections for plane-table and hydrographic parties, projections on copper, tracings, and annual report sketches.

Mr. Tennent was transferred to the engraving department in January, and previous to that time had been at work upon register maps, projections, &c.

Mr. Lambert has finished the topography of Wellfleet harbor, Hart and City islands, and Richmond island; and has been at work on the topography of Chesapeake bay No. I, and other miscellaneous matter. He has also executed some beautiful specimens of topography for use of the office. He has finished the New York current chart, and Charleston harbor chart, scale $\frac{1}{10000}$. He left the survey on the 30th September.

Mr. Fornaro has executed the topography of Galveston city and harbor, and has been engaged upon the topography of Beaufort harbor, tracings, projections, and annual report sketches. He has suffered much from sickness for the last three months.

This estimable gentleman died on the 4th November, after a lingering illness of three months. He was a major of topographical engineers in the Swiss service; suffered much from ill health since his arrival in this country, and departed with the esteem and regrets of all who knew him.

Mr. Forsyth joined the office in December, 1850, and was occupied upon register maps, history maps, and tracings, until May, 1851, when he left the office.

Mr. Walker joined the office in December, 1850, and was occupied upon register maps and projects until May, when he joined a plane-table party in the field. He was again attached to the office in November.

Mr. Townsend joined the office in August, and has rendered valuable assistance in making the progress maps. On the 15th October he was compelled to resign from ill health.

Mr. Hergesheimer joined the office on the 1st September, 1851, and has already proved a valuable addition to the department.

Mr. Hebst has executed several pieces of work on contract, and in a highly creditable manner.

Mr. Meyer, Mr. Neidlescioky, Mr. De Ahna, and Mr. Gritzner, have severally been employed for a few weeks in execution of various tracings and reductions upon contract

3. Engraving.—This department was under the charge of assistant W. M. C. Fairfax till the close of January, when, at his own request, he was transferred to the drawing department. From that time till October it was under my direction, J. C. Tennent, esq., assisting me in matters of detail, since which time it has been under the charge of Lieutenant E. B. Hunt, corps of engineers and assistant in coast survey.

A.—The engraving of the following finished maps has been completed: 1. South side of Long Island, No. 1, by J. Knight, H. Knight, and O. A. Lawson; 2. Hart and City islands and Sachem's Head, by F. Dankworth, W. Smith, H. Knight, R. T. Knight, and J. V. N. Throop; 3. Hell Gate, by G. McCoy, F. Dankworth, and J. Knight; 4. Mobile entrance, (original and electrotype,) by R. T. Knight, J. Knight, F. Dankworth, and W. Smith; 5. Richmond's Island harbor, (being the preliminary sketch filled in with topography,) by Wm. Smith, F. Dankworth, J. V. N. Throop, G. McCoy, and S. Siebert.

B.—The engraving of the following sketches and preliminary charts has been completed: 1—3. Reconnaissance chart, (McArthur,) western coast, by S. Siebert, J. V. N. Throop, W. Smith, J. Knight, R. T. Knight, O. A. Lawson, E. F. Woodward, G. McCoy, A. Rolle, and F. Dankworth; 4. Richmond's Island harbor, by Wm. Smith and J. V. N. Throop; 5. Nantucket shoals, by J. V. N. Throop, O. A. Lawson, J. Knight, and R. T. Knight; 6—8. Second edition (McArthur) western coast, by G. McCoy; 9. Hatteras inlet, (resurvey,) by W. Smith, R. T. Knight, and J. V. N. Throop; 10—14. Five diagram maps of Cat island tides, by J. V. N. Throop, R. T. Knight, T. D. Donohoo, H. Knight, and T. H. Oehlschlager; 15. Reconnaissance of Mosquito inlet, by G. McCoy, W. Smith, and T. D. Donohoo, (per contract); 16. Reconnaissance of Horn Island pass, by H. Knight, R. T. Knight, and T. D. Donohoo; 17. Point Conception, by H. Knight, W. Smith, J. V. N. Throop, and T. H. Oehlschlager; 18. Point Pinos and Bay of Monterey, by H. Knight, R. T. Knight, J. V. N. Throop, and H. C. Evens; 19. Mare Island straits, by W. Smith, J. V. N. Throop, G. McCoy, W. H. Dougal, H. Knight, R. T. Knight, and T. D. Donohoo; 20. Current chart of Boston harbor, by H. Knight and R. Knight; 21. Reconnaissance of Cedar keys, by J. V. N. Throop, R. T. Knight, and H. Knight; 22. Reconnaissance of the Delta of the Mississippi, by W. Smith, E. F. Woodward, G. McCoy, and J. V. N. Throop, (per contract;) 23. Reconnaissance of Pass Christian, by H. Knight, J. V. N. Throop, W. Smith, T. D. Donohoo, and H. C. Evens; 24. Galveston bay, by H. Knight, J. V. N. Throop, R. T. Knight, and T. D. Donohoo; 25. Aransas Pass, by J. V. N. Throop, R. T. Knight, and T. H. Oehlschlager; 26. Trinidad bay, by G. McCoy, W. H. Dougal, and J. V. N. Throop; 27. Entrance of Columbia river, by E. F. Woodward; 28. Cape Hancock, by G. McCoy and Wm. Smith; 29. Holmes' Hole, by J. Acker-

man; 30—36. Seven maps of progress and geographical positions for annnal report.

C.—The engraving of the following finished maps has been continued: 1. General coast chart, by F. Dankworth, O. A. Lawson, G. McCoy, and J. Knight; 2. No. 1, Long Island sound, by J. Knight, A. Rolle, O. A. Lawson, G. McCoy, and S. Siebert; 3. No. 1, Chesapeake bay, by O. A. Lawson and F. Dankworth; 4. Patapsco river, by O. A. Lawson and F. Dankworth; 5. No. 2, south side of Long Island, by O. A. Lawson and J. Knight; 6. No. 1, eastern series, by S. Siebert, J. V. N. Throop, and J. Knight; 7. Boston harbor, by A. Rolle, G. McCoy, H. M. Knight, and J. Knight; 8. Muskeget channel, by F. Dankworth, and E. F. Woodward.

D.—The engraving of the following finished maps has been commenced: 9. Charleston harbor, by E. F. Woodward, F. Dankworth, S. T. Pettit, and G. McCoy; 10. Key West, by E. F. Woodward, W. Smith, F. Dankworth, and H. M. Knight; 11. Connecticut river, by S. Siebert, G. McCoy, W. Smith, W. H. Dougal, and T. D. Donohoo; 12, 13. Nos. 1 and 2, Mobile bay, by F. Dankworth.

E.—The engraving of the following sketches and preliminary charts has been commenced: 1. Seacoast of Delaware and Maryland, (plate enlarged by electrotyping additional engraving work of hydrographic parties,) by W. Smith and J. Knight; 2. Beaufort harbor, by S. Siebert, J. V. N. Throop, H. M. Knight and R. T. Knight; 3. Humboldt bay, by W. Smith, T. D. Donohoo, and H. C. Evans; 4. Harbor of Key West, by A. Rolle, W. Smith, E. F. Woodward, R. T. Knight, H. M. Knight, and T. D. Donohoo; 5. Entrance of the Chesapeake, by S. Stull; 6. Re-engraving of Nantucket shoals, by J. H. Goldthwait; 7. Harbor of San Diego, by E. Yeager and T. D. Donohoo; 8. Entrance of San Francisco, by S. Siebert, E. F. Woodward, and J. V. N. Throop; 9. Savannah river, vicinity of Savannah, by J. V. N. Throop, H. M. Knight, T. H. Oehlschlager, T. Donohoo, and H. C. Evans; 10. Savannah entrance, by J. V. N. Throop and E. Yeager; 11. Mobile bay, by H. M. Knight, R. T. Knight, J. V. N. Throop, and H. C. Evans; 12. Bull's bay, (re-engraving,) by J. V. N. Throop, and T. Donohoo; 13. Entrance of Columbia river, by E. F. Woodward, W. Smith, J. V. N. Throop, and G. McCoy; 14—16. New edition of McArthur's chart of the western coast, by G. McCoy and W. Smith; 17. Point Pinos, (view,) by S. V. Hunt; 18. View of the mouth of the Columbia river, by G. McCoy; 19—26. Eight maps of progress and geographical positions.

Electrotyping.—Mr. Mathiot has made, by the electrotyping process, during the past year, 16 engraved plates, all of which have been used by the printer. 1. Edgartown harbor; 2. New London; 3. New York (second electrotype copy;) 4, 5, 6. Sheets Nos. 1, 2, 3, McArthur's chart of the western coast; 7. Sheet No. 2, McArthur's chart of the western coast (second electrotype copy;) 8. No. 2, south side Long Island, (second electrotype copy;) 9. Mouth of the Columbia river; 10. Seacoast of Delaware and Maryland, (greatly enlarged;) 11, 12. Two copies of Hart and City islands, and Sachem's Head; 13. Sketch of Section IX; 14. Mobile entrance; 15, 16. Third and fourth electrotype copies of New York.

Mr. Mathiot has likewise furnished the engraving department 57 blank plates for engraving; inspected all the copper-plates purchased during the year; made eighteen metre scales by the electrotyping process; applied forty-two days' work, of ten hours each, to repairing magnetic and electric apparatus for the party employed in determining longitudes by the magnetic telegraph, and in partly making metallic thermometers for deep-sea temperatures. These thermometers are about two-thirds done, and have been suspended for want of material to complete them.

Two weeks have been occupied in removing the electrotype apparatus to the building now occupied by it, and about twenty days in repairing derangements occasioned by the removal. Much time has also been occupied in renovations, changes, and the introduction of improved processes, as has been previously adverted to.

Printing.—Since the 1st of November, 1850, there have been printed from Delaware bay and river (electrotype plate No. 1) 2,202 sheets, (this map consists of three sheets;) from the western part of the southern coast of Long Island, (electrotype No. 2,) 1,274 copies; from the small map of the bay and harbor of New York, (electrotype No. 2,) 650; No. 3, 600; No. 4, 600 copies; from the large map of New York bay and harbor, (original plates,) 300 sheets, (this map consists of six sheets); from the harbors of Cat and Ship islands, (electrotype No. 1,) 520 copies; from the western coast reconnaissance, (original plates,) 1,842 sheets; (electrotype No. 1,) 4,728 sheets, (this map consists of three sheets); from Pasquotank river, (electrotype No. 1,) 333 copies; from Cawkins and Sheffield islands, (electrotype No. 1,) 290 copies; from Hyannis harbor, (electrotype No. 1,) 200 copies; from Hart and City islands and Sachem's Head harbor, (electrotype No. 2,) 1,207 copies; from preliminary sketch of Richmond's island, (original plate,) 100 copies; from harbor of New London, (electrotype No. 2) 250 copies; from Oyster or Syosset bay, (electrotype No. 1,) 500 copies; from Huntingdon bay, (electrotype No. 1,) 500 copies; making in all 16,096 sheets.

Besides these, there have been printed 891 copies from the annual sketch plates; 382 from Davis' New South shoal; 250 from the seacoast of Delaware and Maryland; 426 from Hatteras shoals; 230 from Hatteras inlet; 30 from St. Andrew's shoals; 50 from Beaufort harbor; 375 from Cape Canaveral shoals; 600 tidal diagrams; 11,062 Cat island tides; 2,899 proofs of finished and unfinished plates and annual sketches; 325 circular protractors and scales of shades. There have also been 255 sheets antiquarian and 10 sheets double-elephant paper stretched in the printing office since the 1st of January, 1851.

Publishing.—At the date of the last report 29 sheets of Coast Survey maps and 11 sketches had been published; these numbers have since been increased to 37 charts and 33 sketches.

Since November, 1850, there have been distributed, by direction of the Treasury Department, and for use in the survey, 1,104 sheets of Delaware bay and river, 554 copies of Hyannis harbor, 549 copies of Pasquotank river, 565 copies of harbors of Cat and Ship islands, and 1,704 sheets of the western coast. The whole number of sheets distributed is 4,476.

There have been turned over to the disbursing officer of the Coast

Survey, to be placed with agents for sale, 150 sheets of the large map of New York bay and harbor; 1,224 sheets of Delaware bay and river; 651 copies of small map of New York bay and harbor, 110 copies of New Bedford, 309 copies of Nantucket harbor, 162 copies of the harbors of Cawkins and Sheffield islands, 195 copies of Hyannis harbor, 234 copies of Pasquotank river, 348 copies of the harbors of Cat and Ship islands, 3,200 sheets of the western coast, 221 copies of the western part of the southern coast of Long Island, 587 copies of Hart and City islands and Sachem's Head habor,—being in all, 7,391 sheets of maps.

Instrument making and repairs.—The alterations, repairs, dividing and cleaning, required by the instruments of the field and office parties, generally, have been made during the past year under the direction of Joseph Saxton, esq.

Besides, there have been made two trestles for base apparatus, two deep-sea buckets, a telegraph cylinder, a ruling machine, a plane-table, three tripod stands for telescopes, six iron plummets, thirteen metre chains; a ten-inch vertical circle has been altered into a theodolite, theodolites repaired, heliotropes repaired and adjusted, sextants and drawing instruments repaired.

Archives and library.—Mr. C. B. Snow, in charge of the archives and library, has re-registered the original and duplicate geodetic work, securing simple and convenient reference; separated the hydrographic and topographic reductions of original maps into their appropriate sections, and opened a new register, arranged chronologically, with an alphabetical index; superintended the binding of the original and duplicate sounding and angle books; nearly finished arranging the hydrographic and topographic sheets in single tubes; superintended the force employed in copying sounding and tidal observations required to correct errors and complete duplicates, which duty will soon be completed; examined the returns of the permanent tidal observers, and reported as to completeness; and placed the library in condition for convenient use.

Miscellaneous.—The foregoing office-work has been generally under the immediate direction of the assistant in charge of the office. I proceed to notice other office duties conducted under my own immediate superintendence.

The examination of the hydrographic work returned by the different parties, the revision of sailing directions and lists of dangers, the comparison of charts prepared at different periods, the general direction of tidal computations according to prescribed form, and various miscellaneous hydrographic work, would occupy the time and attention of an accomplished hydrographer, with several assistants. During the past year, much aid has been derived from the labors, under my immediate direction, of Lieutenant Wm. B. Whiting, United States navy, who was detailed for coast survey service in March last; in examining portions of the work in various sections, and in revising other portions, and in reporting on subjects occurring during the progress of reduction of the charts. He has also computed the tidal observations at seven stations, and has directed the reductions made by Passed Midshipman

Somerville Nicholson, United States navy, sub-assistant A. S. Wadsworth, and Mr. C. T. Jardella.

Professor Pendleton, United States navy, assistant in the coast survey, has, since his return from duty with the party of Lieutenant Commanding Woodhull, been engaged in the computations of moon culminations as observed in 1846 at Washington, Georgetown, Philadelphia, and Cambridge, with their corresponding ones in European observatories, for differences of longitude. He has also compared the results previously obtained for 1843, '44, '45, and '46, with the check computations of a second computer, and is employed in the observations of the same class made at San Diego, California.

The discussion of the tides at Cat island, Louisiana, and of Fort Morgan, Alabama, has been in progress under my immediate direction by Mr. W. W. Gordon, assisted by Mr. P. B. Hooe. I am indebted, also, for aid in this and other discussions of observations, to Lieutenant W. P. Trowbridge, of the corps of engineers, attached to my party. The tidal observations at Key West, and at Galveston, are under examination under my special direction.

Woods Baker, esq., has rendered useful aid in the office-work of the superintendent, both in the business work and scientific details.

Brevet Captain G. W. Lay, United States army, who was detached for coast survey service in December last, has been on special duty under my immediate direction during the greater part of the time, particularly in connexion with the names of positions; and has rendered valuable aid in the preparation of my annual report.

The disbursements under the charge of Samuel Hein, esq., and the business arrangements committed to him incidentally, have been made with an order and method, and care, which is characteristic of him. His experience in the details of the work, and his entire devotion to it, render his services of the highest value.

In conclusion, I present to the department those employed in the various branches of the survey, in the office, in the field, and afloat, as having executed faithfully the duties intrusted to them, and deserving the approval of the executive and legislative authorities.

Respectfully submitted by

A. D. BACHE,
Superintendent U. S. Coast Survey.

Hon. THOMAS CORWIN,
Secretary of the Treasury.

CONTENTS OF APPENDIX.

and extension of the present light-house establishment; and extracts from their replies.

No. 17. Table of light-houses, beacons, buoys, &c., recommended by chiefs of hydrographic parties of the coast survey, for which no appropriations have been made.

No. 18. Letter of Sears C. Walker, esq., assistant in the coast survey, to the Superintendent, communicating an arrangement with the president of the Maine Telegraph Company to determine the difference in longitude of Cambridge and Halifax.

No. 19. Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating the result of an examination, by Lieutenant Commanding M. Woodhull, United States navy, assistant in the coast survey, into the necessity for certain aids to navigation on the coast of Maine, in accordance with the act of Congress and instructions of the Treasury Department.

No. 20. Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating, with his approval, the recommendation of Lieutenant Commanding M. Woodhull, United States navy, assistant in the United States coast survey, to place a light-boat on Shovelful shoals.

No. 21. Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating a report of Lieutenant Commanding C. H. McBlair, United States navy, assistant in the United States coast survey, on the erection of "bug" or harbor lights at Holmes' Hole, Martha's Vineyard.

No. 22. Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, recommending certain aids to navigation required by act of Congress and instructions of the Treasury Department.

No. 23. Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, on ranges in New York harbor, with extracts from the report of assistant J. B. Glück.

No. 24. Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, recommending certain aids to navigation on the coast of New York and New Jersey required by act of Congress and instructions of the Treasury Department; and communicating the report of Lieutenants Commanding Jenkins and Woodhull.

No. 25. Report of Sears C. Walker, esq., assistant in the coast survey, communicating the measures of wave-time made from 1849 to 1851.

No. 26. Abstract of reports on longitudes by Sears C. Walker, esq., assistant in the coast survey, to the Superintendent.

No. 27. Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, recommending a light-house at Fishing Battery, in Chesapeake bay; and report of examinations by Lieutenant Commanding J. J. Almy, United States navy, assistant in the coast survey.

No. 28. Extract from the report of Henry L. Whiting, esq., assistant in the coast survey, to the Superintendent, on the survey of Beaufort, North Carolina.

No. 29. Letter of the Superintendent of the Coast Survey to the

Secretary of the Treasury, communicating a report of Lieutenant Commanding J. N. Maffitt, United States navy, assistant in the coast survey, upon the necessity for certain aids to navigation in Beaufort harbor, North Carolina.

No. 30. Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating a report of Lieutenant Commanding J. N. Maffitt, United States navy, assistant in the coast survey, on the necessity for a light-house on the Upper Jettee, Cape Fear river.

No. 30, *bis*. Letter from the president of the Chamber of Commerce, of Charleston, South Carolina, to the Superintendent of the United States coast survey, requesting a tracing of the chart of Charleston harbor.

No. 30, *tris*. Report of the Superintendent of the United States coast survey to the Secretary of the Treasury, communicating sailing directions for the entrance into North Edisto harbor, by Lieutenant Commanding J. N. Maffitt, United States navy, assistant in the coast survey.

No. 31. Report of F. H. Gerdes, esq., assistant in the coast survey, to the Superintendent, on the reconnaissance of the coast of Florida, from the Suwannee river to the St. Martin's reef.

No. 32. Extracts from the report of Lieutenant Commanding John Rodgers, United States navy, assistant in the coast survey, to the Superintendent, of a reconnaissance of Mosquito inlet.

No. 33. Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, in regard to the expediency of placing buoys in Mosquito inlet, Florida; and transmitting the report of Lieutenant Commanding John Rodgers, United States navy, assistant in the coast survey.

No. 34. Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, upon the necessity for a light-house or permanent beacon on the Rebecca shoal, between the Tortugas and Marquesas, coast of Florida.

No. 35. Report of Lieutenant Commanding C. P. Patterson, United States navy, to the Superintendent of the Coast Survey, on buoys and beacons for entrances to Mobile bay.

No. 36. Report of Lieutenant Commanding C. P. Patterson, United States navy, to the Superintendent of the Coast Survey, on buoys for Cat and Ship Island harbors.

No. 37. Letter of the Superintendent of the Coast Survey to James E. Saunders, esq., of Mobile, communicating sailing directions for Horn Island Pass.

No. 38. Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, on light-houses in Galveston bay.

No. 39. Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, recommending a light-boat and buoys at Aransas Pass; and transmitting the report of the examination by Lieutenant Commanding T. A. M. Craven, United States navy, assistant in the coast survey.

No. 40. Tribute of respect to the memory of Lieutenant Commanding W. P. McArthur, United States navy, assistant in the coast survey.

No. 41. Report of the Superintendent of the Coast Survey to the

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No. 41, *bis.* Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, on the latitude and longitude of Point Conception, California.

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APPENDIX No. 1.

Distribution of the parties of the Coast Survey upon the coast of the United States, during the surveying seasons, in the different parts of the coast, from November, 1850, *to November,* 1851.

No. of sections of survey.	Limits included in several sections.	No. of parties in section.	Operations.	Persons conducting the operations.	Localities of the several operations.
I	Passamaquoddy bay to Point Judith, including the coast of Maine, New Hampshire, Massachusetts, and Rhode Island.	1	Primary triangulation and astronomical and magnetic observations.	A. D. Bache, superintendent; Lieut. W. P. Trowbridge, corps of engineers, and assistant; Geo. W. Dean, sub-assistant.	Mount Pleasant, Maine, occupied for geodetic and astronomical observations; Ossipee Mt., Maine, for geodetic, and Cape Small Point, Maine, for astronomical observations. (See also Section III.)
		2	Magnetic observations -	J. E. Hilgard, assistant - -	Saco, Kennebunk, and Portland harbors.
		3	Reconnaissance - -	C. O. Boutelle, assistant; Brevet Major Henry Prince, United States army.	Extension of primary stations beyond Penobscot. (Part of season; see also Section V.)
		4	Secondary triangulation -	Captain T. J. Cram, United States topographical engineers, assistant.	Sub-section from Portsmouth, New Hampshire, to Saco, Maine, completed and connected with primary triangulation.
			Secondary triangulation -	C. O. Boutelle, assistant - -	Reconnaissance for secondary triangulation, Casco bay, Maine, part of season.
		5	Topography - -	Alex. W. Longfellow, assistant -	Newburyport harbor, Massachusetts.
		6	Topography - -	Henry L. Whiting, assistant; R. M. Bache, aid. (Double party.)	South and east shores of Cape Ann, Massachusetts, from Beverly Farms to Halibut Point. (See also Section IV.)
		7	Topography - -	J. B. Gluck, assistant. (Double party.)	Chatham and vicinity, and Wellfleet, Cape Cod, Massachusetts. (See also Section III.)
		8	Hydrography - -	Lieutenant Commanding Charles H. McBlair, United States navy, assistant; Lieut. Com'g Samuel Swartwout. (Double party.)	Nantucket shoals; Bass Rip; Davis' Bank; Fishing Rip; Muskeget channel, off Bond island; and Gay Head, Salem harbor, and its approaches.

		9	Hydrography - -	Lieutenant Commanding Maxwell Woodhull, United States navy, assistant.	Newburyport harbor, Massachusetts; approaches to Portsmouth harbor, New Hampshire; Chatham harbor, Massachusetts; tides and currents of Vineyard sound, Buzzard's bay and passages connecting.
			Inspection - -	Brevet Major I. I. Stevens, corps of engineers, assistant.	Inspection of progress of certain parties during part of season.
			Special duty - -	Brevet Captain G. W. Lay, United States army, assistant.	During part of season.
II	Point Judith to Cape Henlopen, including the coast of Connecticut, New York, New Jersey, Pennsylvania, and Delaware.	1	Triangulation - -	Edmund Blunt, assistant; Lieutenant Jos. S. Totten, United States army, assistant.	Hudson river, from limits of former work. (Part of season; see also Section III.)
		2	Topography - -	Henry L. Whiting, assistant -	Re-survey of Sandy Hook to determine its changes. (Part of season.)
		3	Topography - -	J. B. Glück, assistant - -	Survey for ranges for Flynn's Knoll and Swash channel. (Part of season.)
		4	Hydrography - -	Lieutenant Commanding Maxwell Woodhull, United States navy, assistant.	Verification on south side Long Island, from Neapeague to Montauk, and eastward. Revision of entrance to Connecticut river. (See also Section I.)
		5	Hydrography - -	Lieutenant Commanding Samuel Swartwout, United States navy, assistant.	Off-shore work and tides and currents, between Gay Head and Cape May.
		6	Hydrography - -	Lieutenant Washington A. Bartlett, United States navy, assistant.	Minute survey of Way's reef, Pot Rock, &c., at Hell Gate, for changes by blasting.
III	Cape Henlopen to Cape Henry, including the coast of Delaware, Maryland, and Virginia.	1	Primary triangulation and astronomical observations.	A. D. Bache, superintendent; Geo. W. Dean, sub-assistant.	Observations of latitude and azimuth at Causten's station, near Georgetown, D. C. (Part of season; see also Section I.)
		2	Primary and secondary triangulation.	Edmund Blunt, assistant, and Lieut. J. S. Totten, U. S. army, assistant	Continuation of triangulation of Chesapeake, and preliminary determination to capes. (See also Section II.)
		3	Astronomical observat'ns	Sears C. Walker, assistant -	Longitude observations at Seaton station.
		4	Secondary triangulation -	John Farley, assistant; George H. Bagwell, aid.	Outer shore of peninsula of eastern shore of Virginia, from Cedar island to Rogue's island.
		5	Reconnaissance - -	Brevet Major Henry Prince, U. S. army, assistant	To connect triangulation of Chesapeake and outer coast. (Part of season; see also Section IV.)

APPENDIX No. 1—Continued.

No. of sections of survey.	Limits included in several sections.	No. of parties in section.	Operations.	Persons conducting the operations.	Localities of the several operations.
III	Cape Henlopen to Cape Henry, &c.—continued.	6	Topography - -	J. B. Glück, assistant -	Verification work on Patapsco river and eastern shore. (Part of season; see also Section I.)
		7	Topography - -	John Seib and S. A. Wainwright, sub-assistants. (Double party.)	Eastern (Chesapeake) shore of Maryland and Virginia, from Sykes' island to Rose Mary; and western shore, from Smith's Point L. H. to Wolf Trap station. (See also Section V.)
		8	Topography - -	George D. Wise, assistant, and Mr. J. A. Denny.	Outer shore of peninsula of eastern shore of Maryland and Virginia.
			Topography - -	J. M. Wampler, sub-assistant, and Mr. Wm. M. Johnson.	Same work during part of season. (See also Sections VIII and IX.)
			Topography - -	Brevet Major I. I. Stevens, corps of engineers, assistant.	Inspection of work on Patapsco.
		9	Hydrography - -	Lieut. Commanding John J. Almy, U. S. navy, assistant.	Outer coast, from Lonesome Hill, Maryland, to South Gargathy, Virginia; and Chesapeake bay.
		10	Hydrography - -	Lieut. Commanding B. F. Sands, U. S. navy, assistant.	Middle Ground entrance to Chesapeake bay. (Part of season; see also Section VIII.)
IV	Cape Henry to Cape Fear, coast of Virginia and North Carolina.	1	Reconnaissance - -	Brevet Major Henry Prince, U. S. army, assistant.	Reconnaissance of Pamplico and Core sounds, &c. (Part of season; see also Section III.)
		2	Astronomical observat'ns	L. F. Pourtales, assistant - -	Connexion of Forbes' Point, near Elizabeth city, and Seaton station, Washington, for difference of longitude.
		3	Secondary triangulation -	J. J. S. Hassler, assistant - -	Currituck sound, nearly to the Virginia line.
		4	Secondary triangulation -	Charles P. Bolles, assistant, and Mr. J. W. Gregorie.	Entrance to Cape Fear river, (N. C.) (See also Section V.)
		5	Tertiary triangulation -	A. S. Wadsworth, sub-assistant, and Mr. Charles Jardella.	From Cape Hatteras (N. C.) south to Ocracoke inlet.
		6	Topography - -	H. L. Whiting, assistant - -	Beaufort Harbor (N. C.) and approaches, &c. (Part of season; see also Section I.)

		7	Hydrography - -	Lieut. Commanding T. A. Jenkins, U. S. navy, assistant.	Fryingpan shoals, near Cape Fear river, (N. C.) (Part of season; see also Sections IV and V.)
		8	Hydrography - -	Lieut. Commanding Richard Wainwright, U. S. navy, assistant. -	Albemarle, Roanoke, and Croatan sounds, completed; Currituck sound commenced.
		9	Hydrography - -	Lieut. Commanding J. N. Maffitt, U. S. navy, assistant.	Entrance to Cape Fear river, (N. C.) (Part of season; see also Section V.)
IV & V	Gulf Stream - -	–	Hydrography - -	Lieut. Commanding T. A. Jenkins, U. S. navy, assistant.	Exploration of Gulf Stream—continued.
V	Cape Fear to St. Mary's river, including coast of South Carolina and Georgia.	1	Primary and secondary triangulation.	C. O. Boutelle, assistant; Lieut. Jos. S. Totten, U. S. army, and Mr. J. W. Gregorie.	East and west ends of Edisto base (S. C.) occupied; lines opened; secondary triangulation of North Edisto and Dawho rivers; reconnaissance for secondary triangulation to Stono river.
		2	Astronomical observations.	C. O. Boutelle, assistant; Prof. Lewis R. Gibbes.	Difference of longitude of Charleston and Savannah stations.
		3	Secondary triangulation -	C. P. Bolles, assistant, and Mr. Geo. A. Fairfield.	South Edisto and Ashepoo rivers and St. Helena sound. (See also Section IV.)
		4	Secondary triangulation -	C. O. Boutelle, assistant, and Mr. J. W. Gregorie.	Preliminary triangulation of entrance to Savannah river. (Close of season.)
		5	Topography - -	Geo. D. Wise, assistant, and Mr. J. A. Denny.	South Edisto entrance and river, and Edisto island, near east end of base. (See also Section III.)
		6	Topography - -	S. A. Wainwright, sub-assistant -	Harbor of Savannah and approaches. (During part of season; see also Section III.)
		7	Hydrography - -	Lieut. Comm'g J. N. Maffitt, U. S. navy, assistant.	Charleston harbor completed; North Edisto harbor of refuge completed; harbor of Savannah completed. Preliminary survey of entrance to Savannah river.
			Inspection of parties -	A. D. Bache, superintendent -	Inspection of progress of parties in Section, &c.
VI	St. Mary's river to St. Joseph's, coast of Florida.	1	Reconnaissance - -	F. H. Gerdes, assistant, and Mr. Henry Ginder.	Preparation of sites of bases; connexion of Tortugas and Marquesas, Cedar Keys, and Crystal river harbor, &c. (See also Section VIII.)
			Secondary triangulation -	F. H. Gerdes, assistant - -	Triangulation of Cedar Keys and vicinity, and of Crystal river harbor, commenced.
		2	Secondary triangulation -	J. E. Hilgard, assistant - -	Triangulation of Florida keys, from Key Biscayne to Soldier key. (Part of season; see also Section I.)
		3	Secondary triangulation -	L. F. Pourtales, assistant, Lieut. Jas. Totten, U. S. army, assistant, and Mr. Ethelbert Mason.	Triangulation of Florida keys continued from Soldier key to Turkey key. (Part of season; see also Section IV.)

APPENDIX No. 1—Continued.

No. of sections of survey.	Limits included in several sections.	No. of parties in section.	Operations.	Persons conducting the operations.	Localities of the several operations.
VI	St. Mary's river to St. Joseph's, &c.—Continued.	4	Topography - -	J. H. Adams, sub-assistant, and Mr. R. M. Bache. (Double party.)	Marquesas, &c., Bahia Honda, &c., Key Biscayne and main, to limits of triangulation, completed. (See also Section I.)
		5	Hydrography - -	Lieut. Comm'g John Rodgers, U. S. navy, assistant.	Key West harbor and approaches completed; Boca Grande, Bahia Honda, reconnaissance of Musquito inlet, (eastern coast of Florida.)
VIII	Mobile bay to Vermillion bay, coast of Alabama, Mississippi, and part of Louisiana.	1	Primary triangulation and secondary triangulation.	F. H. Gerdes, assistant, and Mr. Henry Ginder.	Station points secured. (Part of season; see also Section VI.)
		2	Secondary triangulation -	S. A. Gilbert, assistant - -	Revision of previous work and extension westward into Lake Borgne; Biloxi and St. Louis bays triangulated; signals placed in Lake Borgne and on eastern shore Pontchartrain.
		3	Topography - -	W. E. Greenwell, assistant, and Mr. Wm. M. Johnson.	West Pascagoula river, Mississippi, to Biloxi bay and Back bay; Pass Christian, from Pitcher Point to Henderson's Point.
		4	Hydrography - -	Lieut. Comm'g B. F. Sands, U. S. navy, assistant.	Eastward and westward of Mobile entrance; Pass Christian; reconnaissance of Southwest Pass and Pass ã l'outre, mouths of Mississippi.
			Hydrography - -	Lieut. Comm'g Jas. Alden, U. S. navy, assistant.	Bonsecours bay, near entrance of Mobile bay. (Part of season.)
X	Vermilion bay to the boundary, part of Louisiana and Texas.	1	Primary and secondary triangulation.	Jas. S. Williams, assist., and Spencer C. McCorkle, sub-assistant.	From Base on Galveston island, Texas, and Highland bayou, westward to "Peninsula" station.
		2	Topography - -	Sub-assistant J. M. Wampler -	Head of Galveston bay; entrance to San Jacinto river; delta of Trinity river and Turtle bay;

					East and West bays, near entrance of Galveston bay, to limits of triangulation. (See also Section III.)
		3	Hydrography - -	Lieut. Comm'g T. A. M. Craven, U. S. navy, assistant.	Galveston entrance, approaches and Lower bay.
X & XI	Coast of California and Oregon.	1	Main and secondary triangulation.	R. D Cutts, assistant - -	Determination of Farallones; entrance to San Francisco bay; San Diego harbor.
		2	Geographical determinations.	Geo. Davidson, assistant, and Mr. John Rockwell.	Latitude and longitude of Point Pinos, Monterey, California; of Point Loma, San Diego, California; of Cape Disappointment, Columbia river, Oregon; diff. long. San Francisco and Cape Disappointment.
		3	Topography - -	Richard D. Cutts, assistant, and Mr. Augs. S. Rodgers.	North and south sides of entrance to San Francisco bay; Mare island, for site for fortification and navy yard; sites of light-houses at entrance to San Francisco bay, on Farallones, and on Bird island.
			Topography - -	A. M. Harrison, sub-assistant, and Mr. J. L. Lawson.	Sites of light-houses at Point Conception, at Point Pinos, (Monterey,) at Point Loma, (San Diego, California,) and at Cape Disappointment, (Oregon,) and Point Adams, Oregon.
		4	Hydrography - -	Lieut. Comm'g Jas. Alden, U. S. navy, assistant.	Trinidad bay and river; Humboldt bay, California; views of entrance to Columbia river; general reconnaissance of the coast south of San Francisco; hydrography of the harbor of Monterey; and continuation of reconnaissance of coast south of Monterey.

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APPENDIX No. 2.

A list of army officers on Coast Survey duty, September 1, 1851.

Name.	Rank.	Date of attachment.
Thomas J. Cram	Captain topographical engineers	December 7, 1846
Henry Prince	Captain and brevet major 4th infantry	December 10, 1850
Isaac I. Stevens	1st lieutenant and brevet major engineers	September 14, 1849
Augustus A. Gibson	1st lieutenant 2d artillery	January 17, 1851
James Totten	1st lieutenant 2d artillery	December 10, 1850
William M. Gardner	1st lieutenant 7th artillery	February 1, 1851
Richard H. Rush	1st lieutenant 2d artillery	December 10, 1850
Joseph S. Totten	1st lieutenant 2d artillery	December 10, 1850
George W. Lay	1st lieutenant and brevet captain 6th infantry	December 10, 1850
Edward B. Hunt	2d lieutenant engineers	May 5, 1851
William P. Trowbridge	2d lieutenant engineers	April 18, 1851

APPENDIX No. 3.

List of navy officers on Coast Survey duty, March 1, 1851.

Vessel.	Locality of service.	Name	Rank.	Date of attachment.
Steamer Bibb	Office	C. H. McBlair	Lieut. commanding	April 11, 1849
		H. A. Wise	Lieutenant	Oct. 8, 1849
		C. St. Geo. Noland	do	May 29, 1850
		F. S. Conover	Passed midshipman	Feb. 21, 1851
Schooner Madison	Office	M. Woodhull	Lieut. commanding	Mar. 30, 1848
		E. A. Barnet	Lieutenant	Sept. 8, 1849
		J. H. March	Passed midshipman	1850
		G. H. Bier	do do	July 30, 1850
		Wm. Van Wyck	do do	1850
Steamer Corwin	Office	T. A. Jenkins	Lieut. commanding	Feb. 17, 1849
		J. S. Taylor	Lieutenant	July 18, 1850
	Office	A. S. Baldwin	do	Jan. 9, 1849
		W. A. Bartlett	do	May 29, 1848
		S. Nicholson	Passed midshipman	Oct. 17, 1849
Schooner Gallatin	Section 5	J. N. Maffitt	Lieut. commanding	Feb. 8, 1851
		Daniel Ammen	Lieutenant	1850
		J. D. Bullock	Passed midshipman	Aug. 29, 1849
		J. D. Langhorne	do do	May 29, 1850
		A. C. Rhind	do do	Nov. 27, 1848
Steamer Hetzel	Section 6	John Rodgers	Lieut. commanding	Apr. 27, 1849
		J. D. Read	Lieutenant	1850

APPENDIX No. 3—Continued.

Vessel.	Locality of service.	Name.	Rank.	Date of attachment.
Steamer Hetzel	Section 6	J. Walcutt	Passed midshipman	May 29, 1850
		J. Myers	...do......do	May 29, 1850
		N. T. West	...do......do.	
Steamer Walker	Section 8	B. F. Sands	Lieut. commanding	May 29, 1850
		M. C. Watkins	Lieutenant	Mar. 12, 1851
		W. W. Roberts	Acting master.	
		A. N. Lynch	Assistant surgeon	August, 1850
		Jno. B. McCauley	Passed midshipman	October, 1850
		Jos. Fry	...do......do	1850
Schooner J. Y. Mason	Section 4	R. Wainwright	Lieut. commanding	Dec. 6, 1849
		W. A. Webb	Acting master	Oct. 9, 1850
		Jos. D. Danels	Passed midshipman	1850
		E. Renshaw	...do......do	1850
Schooner Morris	Section 9	T. A. M. Craven	Lieut. commanding	Jan. 29, 1851
		C. E. Fleming	Lieutenant	1850
		D. Bryan	Passed asst. surgeon	October, 1850
		T. Pattison	Acting master	October, 1850
		L. H. Lyne	Passed midshipman	October, 1850
Schooner Ewing	Sections 10 and 11	J. H. Moore	Acting master	1850
		B. R. Mitchell	Assistant surgeon	1848
		Wm. De Koven	Passed midshipman	Dec. 5, 1850
		Wm. Gibson	...do......do	Nov. 29, 1848
	On their way to join party	Jas. Alden	Lieut. commanding	Mar. 19, 1849

		T. H. Stevens	Lieutenant	Mar. 12, 1851
		R. M. Cuyler	Passed midshipman	Aug. 16, 1847
Steamer Jefferson		F. K. Murray	Lieut. commanding	1850
		C. W. Place	Acting master	Jan. 14, 1851
		Chas. Martin	Assistant surgeon	Dec. 31, 1850
		W. H. Wilcox	Passed midshipman	May 29, 1850
		G. Cilley	...do......do	1850
		D. P. McCorkle	...do......do	Aug. 12, 1848

APPENDIX No. 3 *bis*.

List of navy officers on Coast Survey duty, September 1, 1851.

Vessel.	Locality of service.	Name.	Rank.	Date of attachment.
Steamer Bibb	Section 1	C. H. McBlair	Lieut. commanding	Apr. 11, 1849
		H. A. Wise	Lieutenant	Oct. 8, 1849
		C. St. Geo. Noland	....do	May 29, 1850
		Leo. Paulding	Acting master	May 1, 1851
		W. S. Bishop	Assistant surgeon	May 3, 1851
		F. S. Conover	Passed midshipman	Feb. 21, 1851
Brig Washington	Section 1	S. Swartwout	Lieut. commanding	May 3, 1851
		G. W. Doty	Lieutenant	May 2, 1851
		J. D. Bullock	Acting master	Aug. 29, 1849
		J. L. Davis	Passed midshipman	May, 1851
Schooner Madison	Sections 1 and 2	Maxwell Woodhull	Lieut. commanding	Mar. 30, 1848
		G. H. Preble	Lieutenant	Aug. 26, 1851
		E. A. Barnet	....do	Sept. 8, 1849
		J. H. March	Acting master	1850
		S. F. Cowes	Assistant surgeon	May 16, 1851
		G. H. Bier	Passed midshipman	July 30, 1850
Steamer Legaré	Section 3	John J. Almy	Lieutenant commd'g	Mar. 12, 1851
		Thomas M. Crossan	Lieutenant	May 1, 1851
		T. S. Phelps	Acting master	May 1, 1851
		J. S. Gilliam	Assistant surgeon	May 5, 1851

		W. W. Low	Passed midshipman	April 7, 1851
		Horace N. Crabb	...do......do	April 1, 1851
		J. E. Jouett	...do......do	April 1, 1851
Schooner Graham	Section 3	N. B. Harrison	Acting master	May, 1851
		Richard L. Law	Passed midshipman	May 11, 1851
		William Van Wyck.		
Schooner Gallatin	Section 4	J. N. Maffitt	Lieutenant comm'ng.	Feb. 8, 1851
		Daniel Ammen	Lieutenant.	
		A. C. Rhind	Acting master	March 9, 1846
		J. D. Langhorne	Passed midshipman	Jan. 1, 1851
Steamer Corwin	Section 4	T. A. Jenkins	Lieutenant comm'ng.	March 9, 1846
		John S. Taylor	Lieutenant	March 9, 1846
		Paul Shirley	Acting master	June 24, 1851
		R. A. Marr	Passed midshipman	May, 1851
		S. P. Quackenbush	...do......do	July 3, 1851
		. T. Barraud	...do......do	July 29, 1851
		Charles F. Hopkins	...do......do	July 26, 1851
Schr's Nautilus & Meredith	Section 3	B. F. Sands	Lieutenant comm'ng.	March 9, 1846
		M. C. Watkins	Lieutenant	Mar. 12, 1851
		W. W. Roberts	Acting master.	
		A. N. Lynch	Assistant surgeon	March 9, 1846
		J. B. McCauley	Passed midshipman	October, 1850
		William L. Powell	...do......do	Aug. 2, 1851
		S. S. Bassett	...do......do	April 2, 1851
Schooner Ewing	Sections 10 and 11	James Alden	Lieutenant comm'ng.	March 9, 1846
		T. H. Stevens	Lieutenant	Mar. 12, 1851
		Benjamin R. Mitchell.	Assistant surgeon.	
		R. M. Cuyler	Passed midshipman	Aug. 16, 1847
		William Gibson	...do......do	Nov. 29, 1848

APPENDIX No. 3 *bis*—Continued.

Vessel.	Locality of service.	Name.	Rank.	Date of attachment.
	On the way home from the wreck of steamer Jefferson.	F. K. Murray	Lieutenant	1850
		C. W. Place	Acting master	Jan. 14, 1851
		Charles Martin	Assistant surgeon	Dec. 31, 1850
		W. H. Wilcox	Passed midshipman	May 29, 1850
		G. Cilley	...do......do	1850
		D. P. McCorkle	...do......do	Aug. 12, 1848
Steamer Hetzel	Office	John Rodgers	Lieutenant comm'ng	March 9, 1846
		J. D. Read	Lieutenant	March 9, 1846
		J. Myers	Passed midshipman	March 9, 1846
Schooner J. Y. Mason	Office	Rich'd Wainwright	Lieutenant comm'ng	March 9, 1846
		William A. Webb	Acting master	March 9, 1846
Schooner Morris	Office	T. A. M. Craven	Lieutenant comm'ng	Jan. 29, 1851
		L. H. Lyne	Passed midshipman	October, 1850
	Office	W. B. Whitney	Lieutenant	April, 1851
		A. S. Baldwin	....do	Jan. 9, 1849
		W. A. Bartlett	....do	May 29, 1848
		S. Nicholson	Passed midshipman	Oct. 17, 1849

APPENDIX No. 4.

List of Assistant Engineers United States navy on Coast Survey duty, March 1, 1851.

Vessel.	Name.	Rank.	Date of attachment.
Steamer Hetzel	H. Mason	Second assistant engineer	1850.
	S. B. Knox	Third assistant engineer	1850.
Steamer Walker	James G. Young	Second assistant engineer	1850.
	R. C. Potts	Third assistant engineer	1850.
	M. Fletcher	Third assistant engineer	1850.
Steamer Jefferson	B. F. Garvin	First assistant engineer	January, 1851.
	R. H. Long	Second assistant engineer	January, 1851.
	W. A. Nones	Second assistant engineer	January, 1851.
	W. H. Rutherford	Third assistant engineer	January, 1851.
Steamer Legaré	J. Alexander	First assistant engineer	1850.

APPENDIX No. 4 *bis.*

List of Assistant Engineers United States navy on Coast Survey duty, September 1, 1851.

Vessel.	Name.	Rank.	Date of attachment.
Steamer Bibb	D. B. Macomb	Third assistant engineer	May 29, 1851.
	E. S. De Luce	Third assistant engineer	May 29, 1851.
Steamer Legaré	J. M. Adams	Third assistant engineer	May 6, 1851.
	W. H. King	Third assistant engineer	May 8, 1851.
	W. J. Lamdin	Third assistant engineer	May 23, 1851.
Steamer Corwin	T. Kilpatrick	Second assistant engineer	May 12, 1851.
	A. Lawton	Second assistant engineer	May 12, 1851.
	W. S. Stamm	Third assistant engineer	May 13, 1851.
Steamer Jefferson	B. F. Garvin	First assistant engineer	January, 1851.
	R. H. Long	Second assistant engineer	January, 1851.
	W. A. Nones	Second assistant engineer	January, 1851.
	W. H. Rutherford	Third assistant engineer	January, 1851.

APPENDIX No. 5.

Results of the Coast Survey at different periods, from 1844 *to* 1851.

	From 1844 to 1850.	For 1850.	Total from beginning of survey.
Reconnaissance, area in square miles	23,760	3,280	36,680
Reconnaissance parties, No. of	....	4	
Base lines..........do	4	1	6
Preliminary base lines....do	8	3	13
Base lines, length of, in miles	44½	17½	81½
Triangulation, area in square miles	12,732	2,097	23,905
Extent of coast line	554	305	1,169
Extent of shore line, reckoning bays, sounds, &c.	4,831	902	8,948
Horizontal angles, stations, &c., No. of	946	157	2,120
Vertical angles, stations.......do	35	13	64
Triangulation parties.........do	....	18	
Latitude stations..........do	30	6	45
Longitude stations..........do	18	2	21
Azimuth stations..........do	22	4	35
Latitude stations.. extra ...do	....	2	
Longitude stations. extra ...do	....	6	
Astronomical stations.........do	38	7	54
Astronomical parties.........do	....	5	
Magnetic stations..........do	97	9	106
Magnetic parties..........do	....	4	

APPENDIX No. 5—Continued.

	From 1844 to 1850.	For 1850.	Total from beginning of survey.
Meteorological stations, No. of	11	5	16
Meteorological parties....do	....	2	
Topography, area in square miles	3,107	292	9,621
Length of shore line in miles	5,005	768	11,873
Topographical parties, No. of	....	11	
Hydrography, area in square miles	16,197	2,353	28,173
Hydrographical parties, No. of	....	10	
Hydrography, number of soundings	1,216,026	264,323	2,288,496
Gulf Stream, number of soundings for temperature	1,410	24	1,434
Gulf Stream, number of fathoms line	139,747	914	140,661
Tidal stations, temporary, No. of	60	12	141
Tidal stations, permanent..do	61	15	107
Tidal parties..............do	....	11	
Current stations..........do	293	44	337
Current parties...........do	....	2	
Specimens of bottom	4,384	292	5,176
Total number of manuscript maps	337	72	735
Of these, number prepared in office	130	24	183
Original topographical maps, No. of	120	21	301
Containing sheets	155	30	483
Original charts	84	13	200
Duplicates (charts)	3	....	37

Containing sheets	188	28	452
Records, triangulation, base, &c., No. of vols.	271	40	410
Astronomical observations .... do	168	30	215
Astronomical differences of longitudes . do	107		
Computations, geodetic .... do	179	8	266
Computations, astronomical .... do	148	16	170
Magnetic observations .... do	40	5	49
Magnetic computations .... do	21	....	21
Geodetic books (duplicate) .... do	147	23	197
Meteorological books .... do	10	....	10
Meteorological books (duplicates) .... do	3	....	3
Original hydrographical books, soundings, and angles, No. of vols.	514	170	863
Duplicates of same .... do	44	12	83
Hydrographic books, tidal and current observ's, and tidal reductions, No. of vols.	221	62	291
Total records .... do	1,870	424	2,742
Volumes in the library .... do	750	590	1,340
Engraved plates of maps, No. of	35	10	50
Engraved plates electrotyped . do	12	25	37
Published maps .... do	27	6	33
Printed sheets of maps ...... do	39,411	6,773	46,184
Printed sheets of maps distributed, ... No. of	9,526	326	9,852
Printed sheets of maps, for sale by agents . . do	19,794	3,115	22,909
Instruments, value of	$157,893	$4,652	$162,491

APPENDIX No. 6.

List of Coast Survey discoveries and developments.

The true object of the survey is to furnish charts of the coast for purposes of commerce, and making known what was previously unknown. In the course of preparing these, important discoveries are made.

1. Gedney's channel into New York bay, having two feet more water in it than the old channels.

Had the true depth of this channel been known in 1778, the French fleet under Count D'Estaing would have passed into the bay and taken the assembled British vessels. It is probable, from comparing the old and new charts, that this channel then existed.

2. Blake's channel into the Delaware; open when the eastern channel is filled with ice. This discovery has already developed the resources of that part of the State of Delaware in a remarkable way.

3. Davis' South shoal, discovered in 1846, six miles south of the old Nantucket South shoals. This shoal lies in the track of all vessels between New York and Europe, and between New England and the southern States, or New England and South America.

4. Davis' Bank.

5. Two feet more water in Mobile bay than existed six years ago. Mobile entrance has near 20¾ feet at low water.

6. Horn Island channel, on the coast of Mississippi.

7. Blunt's channel, in Delaware bay.

8. Numerous rocks in Long Island sound and Martha's Vineyard sound, and the various bays and harbors connected with them.

9. Two shoals north and east of Nantucket, discovered in 1847.

10. Six shoals near Nantucket, the outermost one 14½ miles from land and having but ten feet of water on it; not marked on any existing chart.

11. The remarkable increase of Sandy Hook, which has been traced from the surveys of the topographical engineers and coast survey.

12. The changes in the Delaware, near the Pea Patch.

13. A shoal at the mouth of the Great and Little Choptank, in the Chesapeake bay.

14. McBlair's shoals, off Nantucket, in 1849.

15. Deeper water found on Diamond shoal, and a dangerous nine-feet shoal off Cape Hatteras, 1850.

16. Hetzel shoal, off Cape Canaveral, 1850.

17. New channel into Key West.

18. New channel into Charleston, with same depth of water as the ship-channel, (Maffitt's channel,) 1850.

19. South channel of Columbia river, surveyed and rendered available to commerce.

20. A channel of 2½ fathoms, upwards of a mile wide, distant 11 nautical miles from Bald Head light-house, across the Frying Pan shoals, Cape Fear, N. C., 1851.

21. A channel extending from 3 to 4 miles from the point of Cape

Fear to 8 to 8½ from it, with sufficient water at low tide to allow vessels drawing 9 to 10 feet water to cross with safety.

22. A channel at the distance of 14 nautical miles from Bald Head light-house, one mile wide, with 3½ to 7 fathoms water on it.

23. The Frying Pan shoals extend to the distance of 20 nautical miles from Bald Head light-house.

24. Sixteen, 17, and 18 feet water found at the distance of 17 and 18 nautical miles from the Bald Head light-house.

25. Broad Sound channel into Boston harbor thoroughly surveyed, and marks recommended to facilitate passage through it, 1848.

APPENDIX No. 7.

Notes of a discussion of tidal observations, made in connexion with the Coast Survey, at Cat island, in the Gulf of Mexico, by Professor A. D. Bache, Superintendent of the Coast Survey. (See sketches H, Nos. 2 to 6 inclusive.)

In executing the hydrography of the entrance of Mobile bay and of Mississippi sound, connected tidal observations were made under the immediate direction of Lieutenant Commanding C. P. Patterson, United States navy, assistant in the Coast Survey.

The observations at Cat island, at the entrance to Lake Borgne, Louisiana, and at Fort Morgan, at the entrance to Mobile bay, have undergone more than one discussion, the peculiarities of the tides giving great interest to the observations.

The results, as obtained from a year's hourly observations, day and night, at Cat island, will be given as far as obtained, the steps taken for further progress stated, and the information which has been obtained from other sources, bearing upon this most interesting problem of the tides in the Gulf of Mexico, will be briefly touched upon.

I hope, in the progress of the survey along this part of our coast, to develop the subject of these tides, full of importance to the navigator, and of interest to the man of science. These tides, with special exceptions, ebb and flow but once in twenty-four hours.

The tide-gauge was of the kind known as the box-gauge, with a float and staff, graduated into feet and decimals of a foot. It was placed in the harbor of Cat island, near the light-house, at the extremity of a temporary wharf.

The harbor, as the Coast Survey chart which I now present to the meeting shows, turns its widest and deepest opening to the east.

Apparent time was given by a mark, and the observations were made at mean solar time by applying the equations. The time was of less consequence than ordinary in these observations, from the small rise and fall of the tide, which prevented small differences of time from being noticeable by differences of rise and fall. Slight inequalities, caused chiefly by wind, were also found to affect the observations so materially that it was not deemed advisable to observe oftener than once the hour; and after attempting to determine the epoch of high

and low water by more frequent observations, it was decided that errors would probably be introduced by aiming at a degree of precision which the phenomena themselves did not present.

The observations were made day and night, hourly, for a year, with exceedingly rare omissions, and, as the discussion has shown, with a degree of faithfulness which merits very great praise. The observers were Messrs. Gustavus Würdeman and R. T. Bassett, attached to the coast survey.

The general opinion of nautical men on the subject of these tides is, that they mainly depend upon the action of the wind; and the very regular effect which may be shown to result from a discussion of the tides, in reference to the local action by the wind, lends plausibility to this generalization, which nevertheless is unfounded.

The causes are of a much more general character, and such as usually influence the tides, so modified as to be difficult to bring out; phenomena which are only accessory in the ordinary discussions assuming here the chief and overruling part.

The regular tabulation of the observations was made by Lieut. Commanding C. P. Patterson, who did not fail to perceive that the ordinary methods of discussion of the tides were inapplicable. His removal from the survey on other professional service has devolved upon me the labor of discussing the results.

Their importance, interest, and novelty, so far as our coast and their striking peculiarities are concerned, have justified me in giving much time to the discussion, which has been carried on, under my immediate direction, by Mr. G. W. Dean, sub-assistant in the coast survey, and by Messrs. R. M. Bache, A. S. Wadsworth, jr., and W. M. Johnson.

I am indebted for the diagrams necessary to illustrate the conclusions already arrived at, to Messrs. Bache, Johnson, and Keyser.

I present a part only of the labors of these gentlemen. The whole of the hourly observations for the year have been thrown into the form of curves, and numerous tables for examining and verifying the different hypotheses have been made by them. Though the subject was reached inductively, I do not propose to present it strictly in that form.

The work even now is far from being complete: indeed, we have rather reached the true method of discussion, than have completed the discussion; and we may yet have to modify our hypothesis, though I think not materially. I present it to the association as a work in *progress*. When the investigation for this station is made complete, the application of the methods to the other stations on the Gulf of Mexico will be in a degree mechanical.

It is curious that one among the earliest complete series of tidal observations on record, is of tides ebbing and flowing but once in twenty-four hours. The observations were made by Mr. Francis Davenport, at Batsha, of the tides on the bar of Tonquin, and communicated to Dr. Halley, who gave them, with a diagram connecting the phenomena with the moon's motion in the ecliptic, in the thirteenth volume of the Philosophical Transactions for the year 1683. Newton explained these tides by his lunar theory, but in a way, as appears to me, to leave it doubtful whether he supposed the interference of two ordinary or six-hour tides to produce the phenomena. These tides have been referred to since

by almost every writer of note, who has given a general theory of the tides.

The subject of the diurnal inequality of the tides has been so completely and ingeniously discussed by Mr. Whewell, Master of Trinity, that it may be said emphatically to be his own. He first pointed out the empirical law of variation of this inequality. The first distinct attempt to trace the cause of apparent ebb and flow once in twenty-four hours to the influence of the diurnal irregularity, is also, so far as I know, his. In discussing (Phil. Trans. for 1837, Part I) the tides at Singapore, where the diurnal inequality is very large, he was led to the conclusion, if carried a little further, "at a certain stage of it the alternate tides would vanish." To this effect he attributed the "single-day tides of King George's sound, on the coast of New Holland, as observed by Captain Fitz Roy," and gives the curves for a week's observations on the diagram accompanying his papers. The progress of the diurnal inequality wave along the coast of Europe forms an interesting part of Mr. Whewell's labors, the conclusions of which are given in the same volume of the Philosophical Transactions.

In all these cases, however, there are two tides in the course of the day, so as to bring out the diurnal inequality by the comparison of the consecutive high or low water. The subject is followed up in the eleventh series of tidal researches by Mr. Whewell, and in the appendix, in which the diagram of the tides of Petropaulofsk, in the bay of Avatcha, Kamschatka, approaching very nearly, at certain parts of the lunar month, to the order of single-day tides, is given, to prove that the diurnal inequality may be so large "as to lead to the appearance of only one tide in twenty-four (lunar) hours." The equations of the diurnal and semi-diurnal tide-waves are given in this paper, and the wave produced by certain cases of their interference is discussed. (Phil. Trans. for 1840.)

I do not pretend to give such notice of these important papers as would be necessary in a formal communication. Unquestionably the observations now under examination would have furnished to Mr. Whewell only the means of trying ideas and consequences flowing from those which have been already discussed by him; yet the forms of discussion are original, and perhaps new, and the conclusions present so much of novelty, that they remain to be fully put to the test by more elaborate discussion, and by bringing the results at other places to bear upon the same question. I am forced, by the necessity for brevity, to omit a reference to the learned, ingenious, and elaborate paper of Mr. Airy, in the Philosophical Transactions for 1848.

The small rise and fall of the tides, amounting on the average to but one foot, would seem to make it difficult to obtain the law of the phenomena, even with the aid of the most careful and truthful observations—the class to which those under discussion have proved to belong. In regard both to time and height, we may expect to be baffled by small irregularities, requiring long continuance of observations and comparisons of means to get rid of. Thus far few cases have occurred which do not exhibit more striking coincidences than differences.

1. To show the time of high or low water in such a way that the discussion might be readily generalized, the diagrams, of which a specimen

is before the association, were made, (Pl. 3, or H No. 2.) The hours of the day are the ordinates, and the days of the month the abscissa. The signs H and L show in their proper place the hour of occurrence of high and low water for each day. The time of the moon's superior transit is marked, and the periods of greatest declination, and of crossing the equator. The result is easily generalized, that there is ordinarily but one high and one low water at Cat island in twenty-four (lunar) hours, and that when there are two tides they occur about the time of the moon's crossing the equator, and are usually most regular and strongly marked when in syzigies, with declination nearly zero. Following one set of high and low waters, it will be found that they occur later and later as the lunar day gains on the solar, with very remarkable differences, of which the explanation will be given towards the period of small declinations. The interval from high to low water is generally less by some hours than that from low to high. That as the moon approaches the equator, there are a few days of singular double tides, or of single tides, in which the times from low to high water are very much increased. That when the declination changes its name, a high tide takes nearly the place of a low in time, and *vice versa*, with an interval of irregularity; or, in other words, the tides are displaced by nearly twelve hours.

2. There is, as Mr. Whewell has remarked, no proper establishment to be derived from such tides; yet we may obtain a desirable datum by throwing the results into the form of tables, in which the luni-tidal intervals are arranged according to the days from the zero of declination and the corresponding superior and inferior transits, and for north and south declinations. This will be made more clear by subsequent explanation. These afford a test of the theory of these tides by showing the displacement of the ordinate of high and low water, and might be used for the inverse purpose of forming prediction tables. Such tables of luni-tidal intervals for three months I now submit. They show considerable steadiness and similarity of intervals towards the maximum of declinations and great variations near the zero, and greater discrepancies than is usual in ordinary tides. These are from a series of tables computed by Mr. R. M. Bache for the year, and containing the times of high and low water, deduced from the daily curves, the readings of the gauge, the rise and fall of the tides, the times of the moon's superior and inferior transit, and the moon's declination.

The intervals serve to show that the high water belongs alternately to the superior and inferior transits of the moon, according as the moon's declination is north or south, with a few cases only which admit of doubt. Two sets of luni-tidal intervals were computed (see tables) for three months, to ascertain the proper epoch of reduction, or age of the tide. In one case, the intervals were referred to the superior transit of one day before; and in the other, to the superior transit of two days before. The square of the discrepancy of the mean in the latter case was greater than in the former. An establishment deduced from these numbers for high-water, without correction, would have a probable error, as tried by discrepancy from the mean, of nearly eighty-four minutes. I have little doubt of being able to reduce this error, by computation, much within the limits of observation, so as to give useful

prediction tables. The foregoing results point distinctly to a ruling cause depending upon the moon's declination.

3. The hourly observations for the year were thrown into the form of curves—the abscissas representing the hours, and the ordinates the heights. Of these I present, as characteristic, the months of January and March, (Pl. 4, 5, or H, Nos. 3, 4.) In January the tides are single throughout the month, the rise and fall diminishing towards the zero of declination; and in March, two periods of marked double tides occur. The times of new and full moon coincide nearly with the zero of declination of March; in January the syzigies occur at times of greatest declination. A series of diagrams, prepared for periods of declination zero, show irregularities, or double tides, near these times. Before disappearing, the tide which is lost appears rather as an irregularity than as a real tide, puzzling to the observer, and a severe test of his faithfulness. A similar set of diagrams for the periods of greatest declination show uniformly single tides and the greatest comparative rise and fall at the same periods, whether coinciding with syzigies or with first and last quarters. In computing the heights of spring and neap tides by the common methods, four months gave zero or negative differences.

To discuss the epochs of the phenomena, as compared with greatest and least declinations, I prepared two sets of tables, which require revision. They show sometimes an actual coincidence in the epoch of least tides and zero of declination—sometimes a precedence and sometimes a subsequence—which, when not caused by irregularity of winds, I believe will find a satisfactory explanation; at a mean, there was little advantage in the discussion found from displacing the epoch. The average rise and fall for the second day before the greatest declination was 1.68 feet; for the day next preceding the greatest declination 1.78; for the day of greatest declination 1.81; for the next day 1.86; and for the next 1.77. Tracing a curve from these would give the epoch of greatest rise and fall about 0.75 days after the greatest declination. The average rise and fall on the corresponding days, in reference to declination zero, were 0.96 feet, 0.75, 0.60, (dec. zero,) 0.63, 0.73, the curve giving the epoch about one-sixth of a day after the zero of declination. The numbers, as stated, require revision; and there are causes for apparent displacement, which require further examination.

4. This general examination tends to point to the diurnal irregularity, as Mr. Whewell has stated, as the cause of the occurrence of these single-day tides; a view which is confirmed by such examinations as I have been able to make of the hourly tidal observations at Fort Morgan, at the entrance of Mobile bay. The interference in this case would be between the diurnal tide-wave, which represents the diurnal inequality, and the ordinary semi-diurnal wave; whether this wave has a regular progress along the coast, independently of the semi-diurnal wave, as was at first supposed by Mr. Whewell, or whether its phenomena are local, as he has since been led, from his investigations, to believe. If the observed wave is produced by its interference with a semi-diurnal wave, we can only study the phenomena to advantage after the observed wave has been separated into its components.

5. As a first approximation, I assumed the two waves to be governed by the law of sines, and then determined the curve which would result from the superposition of two such waves, having the same or different origins. The mean of the regular double tides, about the zero of declination, would present a first approximate value of the rise and fall of the semi-diurnal tides, and the mean of double and single tides, at the maximum of declination, would, especially when near the quadratures, give a first approximation to the height of the diurnal tide. The comparisons with the forms of curves already traced, addressing the eye, are easily made.

I present, herewith, diagrams (Pl. 6, or H No. 5) for the case, in which the maximum of the diurnal tide coincides with that of the semi-diurnal; is three hours in advance, (or coincides with mean water falling,) six hours (or coincides with low water,) and nine hours, (or coincides with the second mean, or mean water rising,) using the approximate quantities referred to above for the greatest height of two component curves. It requires little examination to see that neither of the first three forms represents the case, and that the fourth does so remarkably, even in what appear to be small irregularities in the daily curves. This will be seen in the results for October, of which a diagram on a large scale is presented, giving the tidal curves near the zero, and thence up to the maximum of declination, for the first half of the month. In the single-day tides there was the same slow rise compared with fall; sharp rise and fall near high and low water, with the tendency to a stand during the rise; the same excess in the interval of time from low to high water, over that from high to low water. This hypothesis as to the position of the two waves may perhaps be slightly improved by further discussion. It is obvious, from the equation of the curve, (which I have already referred to, as given by Mr. Whewell,) that the form and position of remarkable points will vary with the constants in the component curves, as well as with the position of the origin of each in reference to that of the other.

To carry out the representation graphically, I have drawn the curves for four values of the constants of the diurnal and semi-diurnal, formed from the observations with the same displacement of nine hours in the time of high water of the diurnal curve, and corresponding to the epochs of the maximum declination, two, four, and six days before or after the maximum. These show the general features of the curve sufficiently, and the variations in the times and heights, the passage from single to double tides, and the reverse; and the coincidence with observations is such as to warrant a close numerical discussion.

6. The equation of the curve shows how much the time of high and low water depends on the constants in the diurnal and semi-diurnal curve.

The equivalent of the equation given by Mr. Whewell is—

$$C. \cos 2t + D \cos (t - E) - y = O,$$

in which t is the time in hours from the place of the maximum ordinate of the semi-diurnal curve as an origin; C is the constant of that curve of sines; E is the distance of the maximum ordinate of the diurnal curve

for the former, and D the constant for the curve of sines; y is the ordinate of the complex curve.

By an easy transformation, this takes the form—

$$2\ C. \cos\ {}^2t+D \cos t. \cos E+D. \sin t. \sin E-C=y.$$

$$\text{For } E=9 \text{ hrs.} \quad \text{Cos } E=-\sin E=-\sqrt{\tfrac{1}{2}},$$

$$\text{and } y=2\ C \cos\ {}^2t+D \sin E\ (\sin t-\cos t)-C.$$

The differential co-efficient of which for the case of the maximum or minimum is—

$$\frac{dy}{dy}=-4\ C \cos t.\ \sin t+D \sin E\ (\sin t+\cos. t)=O$$

$$\frac{1}{\sin\ t}+\frac{1}{\cos\ t}=\frac{4\ C}{D \sin E}=\frac{4\ C}{D\sqrt{\frac{1}{2}}},$$

or, since the second term is negative when $t>6$ hours,

$$\text{cosec. } t-\sec t=\frac{4\ C}{D\sqrt{\frac{1}{2}}}.$$

Applying this to the four cases shown in the diagrams—

	hrs.	min.
E=9 hours, C=0.175, D=0.700, we find maximum at.......	10	25.4
=0.615	10	33.3
=0.400	10	51.1
=0.157	11	56.8

and for the intervals between high and low water in lunar hours, 9h. 09.2m., 8h. 53.4m., 8h. 17.8m., and 6h. 06.4m.

We might apply this mode to test the hypothesis, using for the values of C the half difference of the ordinates of six and twelve hours from the mean, and of eighteen and twenty-four hours with the signs changed; and for D, the average of the ordinates of six and eighteen hours from the first mean. The means present the best criterion, because not displaced in this combination, as the equation shows. This mode of proceeding, however, throws the test too much on the weak part of the results—the times of occurrence of high and low water, or of mean water—and does not take in all the points of the curve; and I have, therefore, preferred a different form of discussion.

7. Placing the maximum of the semi-diurnal curve at O hours, in the hypothesis that the high water of the diurnal curve is nine hours in advance of that of the semi-diurnal curve, the two curves cross the line of mean water at three hours, the diurnal curve rising and the semi-diurnal falling; at six hours, the semi-diurnal curve has reached its maximum, and rises again at nine hours to its intersection with the mean water-line, at which time the diurnal curve has reached its maximum; the semi-diurnal curve attains its greatest rise at twelve hours, and the mean level at fifteen; the diurnal curve also descending to the same point at that time.

Within these two intervals from mean level to mean level, the combinations of the ordinates forming the actual tidal curve are exhausted; the part of the curve below the mean level being symmetrical with the above: from three to nine hours, the ordinates of the semi-diurnal curve as subtractive; from nine to fifteen hours additive. The mean is the average between high and low water. The tides of each day will give the forms of the component curves, beginning with the mean,

and ending with it, considering as symmetrical the parts above and below the axis of X.

In tabulating, the branch above the axis should be referred to the mean of the preceding and succeeding low water $\left\{\frac{l+l}{4} + \frac{h}{2}\right\}$ and of the high-water which it includes, and that below to the mean of the two high and of one low-water. From three to nine hours, the difference of the ordinates giving the actual curve, and from fifteen to nine in the reverse order, the sum of the same ordinates, half the sum of the two series of ordinates gives the value of the ordinates of the semi-diurnal curve. The same being repeated with the second branch of the curve, the average will give two results for each day's observation.

The case given in the table on the board, for March 5, will serve to illustrate the simple nature of this method of proceeding.

The mean ordinate for the first and second branches of the curve having been obtained, and the hourly observation which coincides most nearly with it having been found before and after high-water, the hourly observations are arranged from it forwards for seven hours (m,) and backwards for seven (n.) The same is done for low-water (m′ and n′.) The half sums and half differences are taken in each case, and then the means. The computation of the diurnal curve is made in the upper part of the table, and that of the semi-diurnal curve in the lower part. The number representing the mean level is eliminated by the mode of taking the means in each table, and the ordinates below the axis are treated as if having the same sign as those above. The semi-diurnal curve is turned over on its maximum ordinate, and the mean value of a single branch of it found. Then each curve is reduced to zero, in the mean level of the period. The last two columns of the upper and lower part of the table contain, respectively, the curves of sines corresponding to the diurnal and semi-diurnal curves.

In the case shown in the first diagram, the ordinates of the semi-diurnal curve from mean water to high-water, and corresponding nearly to a minimum of declination, and new moon, are 0.00 feet, + 0.02, + 0.03, + 0.05, + 0.04, — 0.02, + 0.02. The moon's declination during the period being about from 2° 54′ S., to 1° 45′ S., this curve obviously contains a residual of the semi-diurnal curve, not taken out; but supposing it to be deduced from a just mean, the corresponding ordinates of a semi-diurnal curve, calculated with 0.04 feet as the maximum, would be 0.00 feet, 0.01, 0.02, 0.03, 0.03, 0.04, 0.04, differing, at the most, 0.06 of a foot, or about three-quarters of an inch, and, in a single instance, the sum of all the six differences being .03 feet, and the average .004.

The ordinates of the semi-diurnal curve are 0.00 feet, 0.14, 0.28, 0.32. The curve of sines computed with the greatest ordinate has, in this case, for its corresponding ordinates, 0.00 feet, 0.16, 0.28, 0.32, differing but .02 feet at the greatest.

At the next period of declination, nearly zero and full moon in the month of March, the ordinates of the diurnal curve deduced are 0.00 feet, 0.05, 0.06, 0.06, 0.08, 0.06, 0.09, and the corresponding computed ordinates 0.00 feet, 0.02, 0.04, 0.06, 0.07, 0.09, 0.09, differing at the greatest 0.03 feet, and on the average, 0.004 feet, the observed ordi-

nate being this time in excess, as it was before in defect. The ordinates of the semi-diurnal curve are 0.00 feet, 0.12, 0.22, 0.26, and the computed ones 0.00 feet, 0.13, 0.24, 0.26, the greatest difference being 0.02 feet, and the average 0.007 feet in excess, as was the former.

For March 12, corresponding to the maximum of the diurnal curves, and to neap tides, (one day after last quarter,) the ordinates of the hourly diurnal curve from mean to high-water, are 0.00 feet, 0.21, 0.36, 0.51, 0.63, 0.69, 0.71, the corresponding ordinates of the curve of sines being 0.00 feet, 0.18, 0.35, 0.63, 0.69, 0.71, in which the greatest difference is 0.03 feet, and the mean + 0.007 in the curve computed from observation. The ordinates of the semi-diurnal curve are each zero. Two days afterwards, viz: March 13, gives for the diurnal curve, 0.00 feet, 0.18, 0.34, 0.47, 0.61, 0.68, 0.74, corresponding to which is the curve of sines, 0.00 feet, 0.18, 0.37, 0,51, 0.63, 0.72, 0.74, in which the greatest difference is 0.04 feet, and the mean — 0.02 feet, the curve of observation having the least ordinates. The semi-diurnal curve is 0.00 feet, 0.00, 0.03, 0.02.

The average of three months taken by weeks, gives, for the mean curve and curve of sines, the following table :

	DIURNAL CURVE.			SEMI-DIURNAL CURVE.	
	From observation.	Of sines.	Difference.	From observation.	Of sines.
Hours.	*Feet.*	*Feet.*		*Feet.*	
0	0.00	0.00		0.00	0.00
1	0.17	0.15	0.02	0.04	0.04
2	0.32	0.30	0.02	0.07	0.07
3	0.43	0.42	0.01	0.08	0·08
4	0.52	0.52	0.00		
5	9.56	0.58	0.02		
6	0.58	0.60	0.02		
	Sum.............		0.01		

These results are shown by a curve in the diagram herewith presented (Pl. 7, or H. No. 6,) on the full scale, the greatest difference between the curve from the obeervation and the curve of the sines being less than a quarter of an inch in the mean, deduced from three months' observations. Whether this will disappear in the mean of more observations, or whether a modification of the hypothesis of displacement of nine hours must be made to meet it, further computations now in progress will show.

8. When this analysis has been made as complete as possible, and applied to the year's observations, it will remain to take up the two series into which we have divided the observations, and to discuss them numerically in detail, as we have heretofore done, generally, in

regard to the known laws of the diurnal irregularity, and of the ordinary tides.

Each determination gives a corresponding value of the maximum, or of the ordinate of high water, and in the case of the mean of the curves for January, February, and March, these maxima are 0.66 feet, 0.65, 0.60, 0.60, 0.58, 0.58. Mean 0.61 feet, differing .03 of a foot from the maximum found directly from the observations, and if the discrepancies are accidental, giving a mean probable error by the variations from the average of 0.02 feet (one-quarter of an inch) of any one of the determinations, and for the mean, 0.01 feet nearly.

9. By the kindness of Colonel Abert, of the topographical engineers, of Major Bache, of the same corps, and of Lieutenant Maury, superintendent of the National Observatory, I have been put in possession of tidal registers which have been kept during the progress of the local surveys made of harbors on the coast of the Gulf of Mexico. The tidal observations of Major Bache, United States topographical engineers, at Key West and the Tortugas, are the most complete of this series, and show, as a general phenomenon, the prevalence of the semi-diurnal wave at that point. I have not yet had the opportunity to examine fully these results, which are, however, under discussion.

APPENDIX No. 8.

Method used in the Coast Survey of showing the results of current observations, by Professor A. D. Bache, Superintendent.

This method, while it is original. may not be new, though I am not aware that the system has been followed by others. It has some analogies with the representations of Berghaus, but is different essentially from them. The principle, and an application to the very elaborate current observations made in Boston harbor, under the immediate direction of Lieut. Charles H. Davis, by Lieut. J. N. Maffitt, are shown in the diagrams now presented to the Association.

Observations of the direction and velocity of the currents at and below the surface have been extensively introduced into the hdrography of the coast survey; their importance needs no remark. For most of the details of arrangement and suggestion in regard to the earlier observations, I am indebted to my brother, the late Lieut. Geo. M. Bache, U. S. N.; for much of the success of execution to Lieuts. Charles H. Davis and Carlisle P. Patterson, U. S. N., who have taken unwearied pains in the matter. For currents below the surface there is still wanted some sure and easy method of determining both direction and velocity, especially the latter elements.

Observations being multiplied at different periods of the current, from slack-water to slack-water, they are projected upon diagrams, showing at a glance the direction and velocity at any particular station. The average of the results is usually obtained by inspection. Dividing the intervals between slack-waters into quarters, we give the mean results for those periods in a table, and place usually upon the chart arrows

indicating the direction or set, and write at the extremity, numbers showing the velocity or rate in miles per hour. In case of the observations made in Boston harbor, the results are so unusally numerous that the lines of direction were confusing to the eye, and the connexion between the results was very difficult to seize, though from the pains taken, the motion of the water was traceable in nearly all its peculiarities, from the entrance through the tortuous passages among the islands, alternately narrowing and expanding to the city wharves.

In the current chart now brought before the Association, the direction and force of the currents are represented by lines, the distance between which is inversely as the rate in miles per hour. The scale was obtained by making the least velocity correspond to nearly half an inch, and the greatest to 0.06 of an inch. The reciprocals of the number of miles per hour are represented by tenths of inches in the diagram, currents of 0.2, 0.5, 1, 1.5, 2 miles per hour being represented by lines parallel to their directions, and distant 0.5, 0.2, 0.1, 0.67, 0.05 of an inch. The chart is on a scale of $\frac{1}{200,000}$. The representation on one of the diagrams corresponds to the *flood*, and in the other to the *ebb*, referring to the motion of the current from slack-water to slack-water. If the current stations were very numerous, the straight lines tangent to the curves of motion of the water (set of the current) would become curves.

It is easy for the navigator to seize the relations of the currents he will meet, even by these tangent lines, to avail himself of the knowledge this imparts of the direct, lateral, and eddy currents, to avoid danger or secure advantage.

The cause of the change of directions and velocities is in most cases well marked, the generalization presented to the eye being connected with the form and position of the land above or below the water. In some cases the chart indicates that the observations should be repeated; and in others that, numerous as the stations are, they should still be increased in number. Its adoption will probably thus react, to improve the observations upon which it is founded.

APPENDIX No. 9.

Report of Professor O. M. Mitchel, Director of the Cincinnati Observatory, to the Superintendent of the Coast Survey, on a new method of recording differences of north polar distances, or declination, by electro-magnetism.

Dear Sir: I have delayed thus far sending you any detailed account of the new methods of astronomical observation in use at the Cincinnati Observatory: partly because the subject was constantly developing by new experiments, and partly because at the New Haven meeting of the American Association for the Advancement of Science, this subject, at my request, was referred to a committee for examination. The report of this committee having now been made, and the whole subject having assumed (by another year's examination and experiment) a more definite and positive form, it is now proper to present some general features of this new method, some results already

reached, and the probable applications which remain to be made when suitable instruments shall have been provided for the purpose.

Observers are well aware of the difference between observations for right ascension and declination. In the first the principle of *repetition* has been extensively introduced, with the best results; while as to the other, reliance is mainly placed on the accuracy of a single bisection of the star observed on one declination wire. More than two years since a plan had been executed by myself, and applied to practice in the Cincinnati Observatory, by which, on the same night, during one and the same transit, a star or other heavenly body could be observed on *ten* declination wires, with all the precision due to a single observation by the old methods. More than a year has elapsed since I presented to the American Association some three thousand observations, taken in twelve nights by the new apparatus (a number exceeding the recorded observations of a whole year at one of the oldest European observatories.) Each of these observations presented an accuracy superior to those obtained by the old methods.

This astonishing rapidity and accuracy gave rise to a debate, and, finally, to the appointment of the committee above alluded to. A multitude of observations have been made during the past year, (and in accordance with the request of the chairman of this committee,) varied, with a view to test in every way the powers of the new machinery. The results, as will be seen by examining the report of the committee, were entirely satisfactory.

It is proper now to state, that by the new invention, the transit instrument is converted (at trifling expense) into a declinometer, or instrument for measuring N. P. D., or declination. The observer is released from the necessity of reading a divided circle, and the position of his instrument at the moment his star is bisected by the declination wire, is, by a single touch, engraved on metal, and stereotyped, to be read and examined when convenience may permit. On the swiftest moving stars, *ten bisections* are readily accomplished and engraved in the space of a single minute of time, and at a maximum hour angle of only thirty seconds of time. These records are now made on a circumference whose diameter is nearly twelve feet, and finally read up by a micrometer of as great perfection as can be applied to the measurement of any minute distances. The instrument used thus far is a transit by Dollond, the property of the United States Coast Survey, and furnished by the Superintendent of that work. It is of old construction, about five feet focus; and although the definition of its object-glass is satisfactory, yet the optical power is low, and a bisection by it is far inferior to one made with a powerful object-glass. The new machinery attached to this transit, to convert it into a declinometer, was made in the observatory by my assistant and myself, and is, of course, comparatively rough. The micrometer was made in this city, and although of workmanship highly creditable to the artist, yet, as it is the first ever constructed on this plan, it has been found comparatively defective, and quite incapable of detecting with certainty the minute quantities which have been presented for its examination. Perhaps no micrometer has ever been submitted to such severe tests.

Thus far in the application of the new methods, my examinations

have been confined to zones not exceeding twenty-five degrees in width. There is no difficulty, however, in extending these researches through the entire heavens, and comprehending on the same night the entire sweep of the meridian from north to south.

In case a known catalogue is under review, the amount of work done during the night will depend solely on the rapidity with which the finders of the telescope can be set. If we allow for each star three minutes, (which, with an assistant to set, has been found sufficient,) we have without difficulty two hundred observations on twenty different objects within the hour, and for a night's work of five hours, one thousand wires or observations recorded on one hundred stars or other objects. If, however, the work done is independent of any catalogue, and we are sweeping the heavens in zones, there is no difficulty in recording both right ascension and declination on single wires just as rapidly as the stars present themselves, even up to three hundred stars per hour of time. This has actually been done. For the purpose, therefore, of cataloguing the heavens, the new methods offer advantages of the highest importance.

We now present some of the results tending to demonstrate the degree of precision already reached in the determination of the differences of declination. As the whole subject was entirely new, no advantage could be gained from the experience of other observatories, and hence the difficulties which have been met were encountered under the most unfavorable circumstances. Having, however, implicit confidence in the great principles involved in the new machinery, I never doubted for a moment that the discrepancies which arose would finally be traced to mechanical defects, or to accidental and unanticipated causes.

My attention has been exclusively directed to this single point: *within what limits of error could the new apparatus repeat its own work on different nights on stars whose difference of declination varied from a second or two of arc up to 25° or 30°?*

To convert the records into degrees, minutes, and seconds, presents no serious difficulty, and has, therefore, not as yet occupied my attention further than to demonstrate with certainty its practicability.

In my very earliest observations with *ten* declination wires, more than two and a half years since, a simple inspection of the record in the shape of ten delicate wedge-shaped dots on metal, with a powerful microscope, demonstrated at once the perfection with which these records were made within the narrow space occupied by these ten dots. The wires were as nearly parallel and equidistant as we could place them. Yet the small inequalities of distance were always measured with a precision only limited by the power of bisection under the circumstances existing during the observation. When the weather was tranquil and the stars steady, the most admirably accordant results were reached: on the contrary, when the stars were dancing or ill-defined, discrepancies were recorded doubtless due to errors of bisection. It is quite unnecessary to present the evidence of accurate movement within the above narrow limits, inasmuch as the wider range of observation will include the more restricted.

When, on a comparison of the work of two different nights, the discrepancies were reduced to the fraction of a second of arc, it became

manifest that the micrometer was (as built) incapable of measuring with certainty such minute quantities. I had neither time nor means to build a new and more perfect instrument; and finding the micrometer reliable for half a dozen revolutions of the micrometer screw, a method of intercomparison of the work of two different nights occurred to me, which, with my defective micrometer, would test in the most absolute manner the powers of the new machinery. This was as follows, viz:

The stars of the catalogue were observed during one night on the *odd wires*, 1, 3, 5, 7, and 9, leaving the spaces blank on the engraved record, which corresponded to the even wires, 2, 4, 6, 8, and 10. Everything remaining untouched, on the following clear night the same stars were observed on these even wires, and thus a decade of dots was recorded, of which five were engraved on one night, and five others on the following one.

These records thus intermingled and interlocked, were now easily read by the micrometer; and falling, as they did, within the limits of reliable performance of the micrometer, the capacity of the instrument to repeat itself on different nights was tested in the most absolute manner, no matter if the stars observed comprehended a zone of even 25° or 30°. It is proper to remark that in all these observations I was assisted by Mrs. Mitchel, the stars being taken by us alternately; the reading up was done principally by herself, while the duty of recording fell to me. In this way the results reached would be independent of any personal idiosyncracy, while the readings being made by one person and recorded by another, no bias could possibly be given to the person reading.

In our first experiment of interlocking observations, forty-eight hours elapsed before it became possible to remove the metal plate from the pier, during which interval of time there were constant changes in the atmosphere, with storms of rain and wind. It was therefore with no small anxiety that, on closing the observations, the microscope was turned upon the decade of dots, the work of two nights, at intervals of forty-eight hours. The examination was in the highest degree satisfactory. The dots were placed with a precision and beauty perfectly astonishing, and no eye, thus far, with the microscope itself, has been able to mark the difference between a decade of dots struck on two different nights, and one struck all on the same night. It did not require the micrometer screw to decide the question as to whether the instrument had repeated itself on the two different nights. This was obvious from a mere inspection of the dots by the microscope. In two instances on the extreme stars there was a slight deviation from the uniformity of the placing of the dots. I suspected this to be owing to the action of the wires attached to the arm and conducting the current from the battery through the electro-magnet. Ample length was given to the wire, but there yet remained in it a sufficient stiffness to affect the place of the arm in its extreme positions, by a minute amount. This was fully demonstrated by experiment on the following night. A star was brought to bisection on a wire, and while thus located the conducting wires were gently touched by the hand of the observer and the instrument was seen to yield to every touch. A source of error was thus detected, of a minute character indeed, but of vast importance

where tenths of seconds of arc were the quantities under examination. The admirable agreement now found to exist uniformly between the work of different nights encouraged me to go back and remeasure, with greater care, the old work still remaining engraved on the plate. By using a mean of two or three measures the observations were brought to the most surprising coincidence. I did not attempt a remeasure of all the observations, but contented myself with a rigid examination of a single pair of N. A. stars, among whose observed differences of declination average discrepancies existed. I copy the final results, remarking simply that the observations were made between the 26th May and the 30th June inclusive.

The following are the decimals of a revolution of the micrometer screw in the ten observations:

						Seconds of arc.
α Coronae	to ε Bootis	.6836	Diff. from	mean	.0017 =	0.068
"	"	.6609	"	"	.0210	0.840
"	"	.6891	"	"	.0072	0.286
"	"	.6883	"	"	.0064	0.256
"	"	.6906	"	"	.0085	0.340
"	"	.6757	"	"	.0052	0.208
"	"	.6699	"	"	.0120	0.480
"	"	.6886	"	"	.0067	0.268
"	"	.6905	"	"	.0086	0.344
"	"	.6784	"	"	.0054	0.220
		.6819	"	"		0.340
					Probable error,	0.250

				Seconds.
α Cor. to ε Bootis,	Greenwich Obs.,		1840	0.05
"	"	"	"	1.61
"	"	"	"	1.64
"	"	"	"	1.02
"	"	"	"	1.25
"	"	"	"	2.67
"	"	"	"	1.39
"	"	"	"	0.81
"	"	"	"	2.05
"	"	"	"	2.52
				1.401 Prob. error, 1″.3

I shall now present a few measures of the sun's diameter, in which it must be observed that only relative quantities are obtained. Taking the N. A. as accurate on any one day of those indicated in the observations, we found the power of the new apparatus to trace the apparent changes in the sun's diameter. This is not yet absolute work.

Observations of the ⊙ diameter at the Cincinnati Observatory, Sept., 1850.

	Obs.	Comp.	Diff.
September 3	1906.68	1906.40	+ 0.28
4	1907.40	1906.80	+ 0.60

	Obs.	Comp.	Diff.
September 5	1906.82	1907.40	− 0.58
6	1907.62	1907.80	− 0.18
7	1906.73	1908.40	− 1.67
9	1910.74	1909.40	+ 1.34
12	1911.58	1910.80	+ 0.78
13	1910.17	1911.40	− 1.23
16	1912.44	1913.00	− 0.56
17	1912.65	1913.40	− 0.75
19	1914.74	1914.60	+ 0.14
20	1916.00	1915.20	+ 0.80
21	1916.62	1915.60	+ 1.02
1851.			
May 15	1900.10	1900.02	+ 0.08
22	1897.80	1897.60	+ 0.20
24	1897.46	1896.80	− 0.66
26	1896.07	1896.20	− 0.13

The work in 1850 was measured with the defective micrometer, and I attribute the increased discrepancies to this cause, rather than to any inaccuracy in the observations or records.

On the application of the principle already explained, of intermingling the observations of two different nights, most of the large discrepancies which had for a long time annoyed me, and which I felt were due to imperfections in the micrometer (but which I had not hitherto been able to demonstrate,) all disappeared, and the results have since exhibited the most surprising harmony. I shall present only a few specimens of the work done, as a more full and elaborate report will be made hereafter.

Observations of June 16 *and* 17, 1851.

	16th.	17th.	Diff.	Sec'ds.
Observer, M. ε Bootis to B. A. C. 4969 L.	6060	6064	0004	0.016
" L. α Coronae.	6508	6420	0088	0.352
" M. 4706.	3397	3288	0109	0.336
" M. α Bootis.	8877	8687	0190	0.760
" M. 4933.	8882	8663	0199	0.796
" L. 5120.	1430	1268	0162	0.648
" L. α Serp.	2245	2252	0007	0.028
				0.418

	16th.	17th.	Diff.	Sec'ds.
M. ε Bootis to 4969 L.	.6060	.6064	0004	0.016
4969 " α Cor. L.	.0448	.0351	0097	0.338
α Cor. " 4706 M.	.6889	.6873	0016	0.064
4706 " α Bootis M.	.5480	.5399	0081	0.324
α Bootis " 4933 L.	.0051	.9946	0095	0.380
4933 " 5120 L.	.2553	.2605	0052	0.208
5120 " α Serp. M.	.0815	.0992	0177	0.738
				0.302

I present one more specimen of the same kind of work, with some slight additional security for accuracy, simply remarking that here again the stars were observed by L. and M. without any specific order:

						Diff.	Seconds.
B. A. C. No. 6084, to		6323	5820	5896	0076	0.304
"	"	ε Bootis	1335	1319	0016	0.064
"	"	α Coronae	1407	1399	0008	0.032
"	"	6657	1662	1662	0000	0.000
"	"	6106	6430	6614	0234	0.936
"	"	6589	7340	7380	0040	0.160
"	"	α Bootis	1530	1670	0140	0.540
"	"	6110	1669	1699	0030	0.120
"	"	α Herculis	9980	0046	0066	0.264
"	"	α Serpentis	0540	0576	0036	0.140
						10)2.560
						2)0.256
						0.1280

Here it will be seen there is no accumulation of error due to the increased distance between the stars observed. This will also become more evident by examining the observations of intervals between wide stars on the preceding nights already reported.

I am now satisfied that the errors which yet remain may be diminished one-half by the use of ten instead of five declination wires; and, finally, that all work for difference of declination between stars may be accomplished with an accuracy equal to the best micrometer work, when the stars are but a few seconds apart.

The best work done in the world, (so far as I know,) has been accomplished in the Imperial Russian Observatory at Pulkova, and is reported by M. Struve in his great work on that institution. By the greatest refinement of art and skill on a few stars, the accordance between the determinations of different nights has been brought to within a limit of probable error of two-tenths of one second of arc. It will be seen by examining the results reported, that the new method, in the very infancy of its application, with defective instruments, low optical power, and with every possible disadvantage to contend with, has already rivalled in accuracy the best work ever done. Indeed, the last work reported greatly surpasses the Pulkova work in accuracy, as the average error on ten differences of declination amounts to no more than twenty-five hundredths of one second of arc, while the average error in the Pulkova observations amounts (on differences of declination) to forty-hundredths of one second of arc.

But the old methods have already been pushed to their ultimate limit of attainable precision. Of this, I think any one will be convinced who will read M. Struve's admirable history of the Pulkova Observatory and its instruments. On the contrary, in the new method, almost nothing has been done. Any one who has used telescopes of low power and those of great power, need not be reminded of the extraordinary advantage which high optical power and good definition gives in bisecting a star.

In the great refractor of the Cincinnati Observatory, ε Bootis is divided into two beautiful stars, some two seconds of arc asunder, each round and sharp; while in the small instrument used in the foregoing observations, the same star appears as a single object, a large mass of light. In case it were possible to employ the optical power of the great refractor, the most astonishing increase of accuracy might be anticipated. If such an object-glass were mounted as a transit, the records would then be made very conveniently on the circumference of a circle thirty feet in diameter, and a second of arc would occupy a space nearly three-fold greater than that now in use by me, and four-fold greater than is elsewhere employed (so far as I know) in the world. Again, thus far, it must be remembered that the preceding results are the means of *five wire observations.* There is no difficulty in increasing the number of wires to ten or even fifteen, should it be desirable. In short, the new method is capable of almost indefinite expansion and increased accuracy—1. By increase of optical power. 2. By perfecting the mechanical arrangements. 3. By increasing the radius of the recording circle. 4. By increasing the number of observations, or the number of declination wires.

The new method also involves a principle of wonderful value in the delicate work to which it must be applied. I mean the power of stereotyping the positions of the instrument, so that the observations may be scrutinized at leisure, and be read and re-read until the error of reading up shall be reduced to an insensible quantity: this cannot be done in the old method.

What, then, may we not anticipate from the application of this new machinery, under favorable circumstances, to the examination of the heavens? If Struve dared pronounce his instrument competent to the determination of parallax, proper motion, &c., with results discrepant to two-tenths of one second, then indeed has the new machinery converted a small inferior transit into an instrument competent to cope with these grand mechanical questions.

Apply it, then, to instruments of perfect construction, of high optical power, with equal advantages of high mechanical perfection, with a full ten-wire diaphragm, interlock the observations until the power of the micrometer is fully and positively determined, and then who will dare to anticipate the results which may be reached by such a combination of science and mechanical power? Motions which have hitherto required centuries for their detection and measurement, variations in the proper motions of the fixed stars, which have only been suspected, parallax annual and systematic—even the position of the double stars themselves—may not all these, to say nothing of aberration, nutation, precession, fall fully within the range of rapid and positive research?

With the delicate and powerful machinery for determining R. A., on which no less than twenty-five wires are successfully employed, combined with this no less powerful means of measuring difference of declination, may we not hope that even in the lifetime of a single observer, some of the dark problems of the heavens which now defy our utmost efforts may be resolved and yield up their long and deeply concealed mysteries? My only regret is, that I do not possess the means to exe-

cute an immediate application of these new methods to the resolution of these high and profound problems.

Very respectfully, your obedient servant,

O. M. MITCHEL.

Professor A. D. Bache,
Superintendent of the Coast Survey.

APPENDIX No. 10.

Extracts from the report of Professor Agassiz to the Superintendent of the Coast Survey, on the examination of the Florida reefs, keys, and coast.

Cambridge, *August*, 1851.

Sir: The following report of the examination made by me of the Florida reefs, keys, and coast, is prepared in compliance with your request:

Topography of Florida.

To form a correct idea of the Florida reefs, it is of paramount importance to keep in mind the topographical features of the whole country. The peninsula of Florida projects between the Gulf of Mexico and the Atlantic, from the 30th degree of northern latitude, nearly to the 24th, as a broad, flat, low promontory, which has generally been considered a continuation of the low lands of the southern States. But, as we shall see hereafter, this is not the case, or, at least, not with respect to the southern extremity of the peninsula, which consists of the same formations as the reef itself. Again, in a physical point of view, Florida is not limited to those tracts of land, forming the peninsula, which rise above the level of the sea, for the extensive shoals along its southern extremity, between the main land and the keys and reefs, as well as those extending to the west as far as the Tortugas, whence they stretch along the western coast, in fact belong to it, and are intimately connected with it, by their physical character. There is a similar tract of flats along the eastern shore, but it is not so extensive as on the southern and western shores, nor does it partake as largely of the peculiar character of the peninsula, being chiefly formed of the alluvial sand, drifted ashore by the waters of the Atlantic.

We shall have occasion, however, to show hereafter that the narrow longitudinal islands, which extend close to the main land almost for the whole length of the eastern shore, are probably a direct continuation of the keys, covered with drifted sand.* This is certainly the case with the range of keys extending from the main land to Cape Florida, which limits to the east the bay of Miami, their formation being of coral rock, but covered by silicious drift-sand.

As to the southernmost extremity of the main land proper, it is very difficult to determine its outlines, as it consists of innumerable islands,

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*A direct investigation of this point, which did not come within the limits of my survey, would be of considerable practical importance, inasmuch as it may lead to the discovery of a basis of coral rock, affording a far more solid foundation for the construction of the light-houses wanted along that coast than the loose shore detritus.

sometimes separated by narrow channels, and sometimes assuming the character of real islands only at high water, being mostly connected with the main land by very shallow flats. This is especially the case along the southwestern extremity of the peninsula. The outline of the southern shore, however, between Cape Florida and Cape Sable, is better defined—presenting, in almost unbroken continuity, steep bluffs of the same coral limestone which forms the bottom of the everglades, and may be traced, without interruption, along the Miami from the sea-shore to the everglades.

South of the main land, between it and the range of keys, there are extensive flats, which, even at high water, are but slightly covered, and which the retreat of the tide lays bare, leaving only narrow and shallow channels between the dry flats, with occasional depressions of greater depth. These mud flats extend not only between the main land and the keys as far as Cape Sable, but may be traced to the north along the western shores of the continent, and to the west along the northern shores of the keys, not only as far as Key West and the Marquesas, but even to the Tortugas.

There is, however, this remark to be made—that to the west the mud flats become covered, by degrees, with deeper and deeper water; or, in other words, that these low grounds, extending between the main land and the main range of keys, dip slightly to the west, being gradually lost in the shoals extending north of the Marquesas and the Tortugas, along the western shore of the peninsula. These flats are interspersed with innumerable low islands, known in the country by the generic appellation of the Mangrove islands, respecting which we shall give further details hereafter.

The shoals between Cape Sable, Cape Florida, and the main range of keys, are literally studded with these Mangrove islands. Sometimes they are distributed without apparent regularity; sometimes, as to the north of Key Largo, they form a continuous range between the main land and the keys. They are also very numerous along the main keys, or at least along that side of them which is turned towards the most extensive mud flats. Sometimes these Mangrove islands form little archipelagoes of innumerable small islets, so intimately interwoven, and separated by such narrow and shallow channels, as to be almost impenetrable. Such archipelagoes occur chiefly to the north of Bahia Honda and the Pine islands, as well as to the northwest of Key West. The luxuriant vegetation which rises from these low islands, consisting chiefly of mangroves, gives them a very peculiar appearance. We shall have occasion to return to this subject, when we attempt to explain the formation of the different islands connected with the Florida reef and the main land. The whole tract between Cape Sable and the keys, east of Bahia Honda, as far as Cape Florida, or at least as far as Soldier key, is so shoal that it will forever remain inaccessible, except to very small vessels.

The keys consist of an extensive range of low islands, rising but a few feet, perhaps from six to eight or ten, or at the utmost to twelve or thirteen feet, above the level of the sea. They begin to the north of Cape Florida, where they converge towards the main land, extending in the form of a flat crescent in a southwesterly direction, gradually

receding from the main land until, opposite Cape Sable, they have so far retreated as to be separated from it by a shallow sheet of water forty miles wide. Farther to the west they project in a more westerly course, with occasional interruptions, as far as the Tortugas, which form the most western group. They consist either of accumulated dead corals, of coral rocks, or of coral sand, cemented together with more or less compactness. Their form varies, but is usually elongated and narrow, their greatest longitudinal extent following the direction of the main range, except in the group of the Pine islands, where their course is almost at right-angles with the main range—a circumstance which we shall attempt hereafter to explain.

Most of these islands are small, the largest of them, such as Key West and Key Largo, not exceeding ten or fifteen miles in length; others only two or three, and many scarcely a mile. Their width varies from a quarter to a third or half a mile, the largest barely measuring a mile across; but whatever the difference in their size, they all agree in one respect—that their steepest shore is turned towards the Gulf Stream, while their more gradual slope inclines towards the mud flats which they encircle.

This is a point which it is important to notice, as it will assist us in our comparison between the keys and the shore bluffs of the main land, as well as with the outer reef and the reefs of other seas, in all of which we find that the seaward shore is steeper than that turned towards the main land, or, in the case of circular reefs enclosing basins (atolls,) than that which borders the lagoon.

The reef proper extends parallel to the main range of keys, for a few miles south or southeast of it, following the same curve, and never receding many miles from it. The distance between the reef and the main range of keys varies usually from six to two or three miles, the widest separation being south of Key West and east of the Ragged keys, where the space is about seven miles. Between this reef, upon which a few small keys rise at distant intervals, and the main range of keys already described, there is a broad, navigable channel, extending the whole length of the reef from the Marquesas to Cape Florida, varying in depth from three to six and seven fathoms, and, except off Looe key, where the passage is not more than fourteen feet deep at low water, averaging from three to four fathoms.

Farther east the average depth is again the same as at Looe key; but it becomes gradually more and more shoal towards the east, measuring usually about two fathoms, or even less, to the east of Long key and Key Largo, but deepening again somewhat towards Cape Florida, where the reef converges towards the main keys and the main land. Protected by the outer reef, this channel affords a very safe navigation to vessels of medium size, and would allow a secure anchorage almost everywhere throughout the whole length of the reef, were the numerous deep channels which intersect the outer reef well known to navigators and marked by a regular system of signals. As it is, however, the reef seems to present an unbroken range of most dangerous shoal grounds, upon which thousands of vessels, as well as millions of property, have already been wrecked. These facts have a stronger claim upon the attention of the government, since there are, as already re-

marked, numerous passages across the reef which might enable even the largest vessels to find shelter and safe anchorage behind this threatening shallow barrier. * * * * * * *

The reef proper, as we have remarked above, runs almost parallel to the main range of keys from Cape Florida to the western extremity of the Marquesas, where it is lost in the deep. It follows in its whole extent the same curve as the keys, encircling to the seaward the ship channel already mentioned. This is properly the region of living corals.

Throughout its whole range it does not reach the surface of the sea, except in a few points where it comes almost within the level of low-water-mark, giving rise to heavy breakers, such as Carysfort, Alligator reef, Tennessee reef, and a few other shoals of less extent, but perhaps not less dangerous. In a few localities fragments of dead coral and coral sand begin to accumulate upon the edges of the reef, forming small keys, which vary in form and position according to the influence of gales blowing from different directions—sometimes in the direction of the Gulf Stream from southwest to northeast, but more frequently in the opposite direction, the prevailing winds blowing from the northeast. Such are Sombrero key, Looe key, the Sambos, and Sand key. Here and there are isolated coral boulders, which present projecting masses above water, such as the Dry Rocks, west of Sand key; Pelican reef, east of it; with many others, more isolated. Though continuous, the outer reef is, however, not so uniform as not to present many broad passages over its crest, dividing it, as it were, into many submarine elongated hillocks, similar in form to the main keys, but not rising above water, and in which the depressions alluded to correspond to the channels intersecting the keys. These broad passages leading into the ship channel, which may be available as entrances into the safe anchorage within the reef, are chiefly the inlet in front of Key Largo and to the west of Carysfort reef, with nine feet of water; a passage between French reef and Pickle reef, with ten feet; another between Conch reef and Crocus reef, also with ten feet; another between Crocus reef and Alligator reef, with two fathoms; another between Alligator reef and Tennessee reef, with two fathoms and a half; and a sixth to the west of Tennessee reef, varying in depth from two and a half to three fathoms.

The remark which has been made respecting the mud flats and their gradual deepening from east to west, applies equally to the general features of the main reef, as well as to the intervening channel. To the eastward the channel is shallower, the ground around the keys and reef becomes shoaler, and there is a gradual dip towards the west, which makes the connexion less marked between the keys west of Key West, in the large groups of the so-called Mangrove islands, and the Marquesas, beyond which there is even an extensive interruption in the succession of the keys before we reach the Tortugas. These last, however, as well as the bank west of these keys, belong none the less to the main range of keys, from which they are only separated by a more extensive and deeper depression. West of Sand key the reef itself becomes gradually less elevated, until it is finally lost where the

ship channel, south of the Marquesas, expands into the broad depression, separating that group of keys and shoals from the Tortugas.

In order to understand fully not only the topography, but also the mode of formation of all these keys and reefs, it must be remembered that the rising reefs, which form more or less continuous walls, reaching at unequal heights nearly to the surface, or above the level of the waters, are only a particular modification of those formations growing upon coral grounds under special circumstances. It has been ascertained, whenever similar investigations have been made, that living corals do not occur in depths exceeding twenty fathoms, that the reef-building species prosper from a depth of about twelve fathoms nearly to the surface, and that different species follow each other at successive heights. Now, if we keep in mind these facts, we shall see that all the coral-bound islands of the West Indies, as well as of the main land of Central America, constitute an extensive coral field, divided by broad, deep channels, over which the coral reefs extend, with different features, according to the depths in which they occur and the changes which their own growth has gradually introduced upon the localities where they are found, influenced and modified to some extent also by the direction of the prevailing currents and the action of the tides.

The formation of the main range of keys in their primitive condition as a reef—for, as we shall see hereafter, they have been a sub-marine reef before they rose as islands above the level of the ocean—the formation of this range, we repeat, at gradually greater distances from the main land, as we follow their course from east to west, has been simply owing to the depth of the bottom from which the reef has risen. It has followed the line of ten or twelve fathoms depth; and if there is so wide an interruption between the Marquesas and the Tortugas, it is because the ground is deeper over that space. Again, if the Pine islands have a northwesterly direction, while the main range runs more from east to west, it is no doubt because the body of water emptying from the northern part of the gulf, along the western shores of the peninsula, has, for a time, run chiefly over that field, while the tract of mud flats between the keys and the main land was filling prior to the formation of the outer reef, the rising of which, as an external barrier, must have modified greatly the course of the currents north of the keys at a later period, leaving between them only a few narrow but navigable channels, such as exist now between the Marquesas and the Mangrove islands, between these and Key West, and between the Pine islands and the group of Bahia Honda.

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We would only add that the absence of corals along the western shore of the peninsula, at present, is probably owing to the character which that shore has assumed in the progress of time, for the peninsula itself has once been a reef, at least as far as the 28th degree of north latitude, as is shown by the investigation of the everglades, and by the examination of the rocks at St. Augustine.

This latitude is the natural northern limit of the formation of coral reefs, as also of the extensive growth of stony corals; though on the southern shores of the North American continent, these formations seem to have extended far beyond their usual bounds, probably under the in-

fluence of the high temperature of the Gulf Stream, for not only do the narrow, longitudinal islands which extend along the eastern shore, and their direct connexion with the small keys north of Cape Florida, indicate their coralline origin, but we have even under the 32d degree of north latitude extensive coral formations at the Bermudas still flourishing in the present day. If the growth of corals has been stopped along the eastern shore, it must be ascribed to the invasion of drift sand, which extends over the everglades, as well as along the eastern shores as far south as the Miami, Key Biscayne, and the bay of the Miami.

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Mode of formation of the reef.

The reefs of Florida as they have been described in the foregoing sketch of the topography of that State, and, indeed, the separate parts of each of these reefs, in their extensive range from northeast to southwest, present such varieties as will afford, when judiciously combined, a complete history of the whole process of their formation.

Here we have groups of living corals, beginning to expand at considerable depth, and forming isolated, disconnected patches, the first rudiments, as it were, of an extensive new reef. There we have a continuous range of similar corals in unbroken continuity for miles, or even hundreds of miles, rising at unequal heights nearly to the surface.

Here and there a few heads or large patches, or even extensive flats of corals, reach the level of low-water mark, and may occasionally be seen above the surface of the waters, when the sea is more agitated than by the simple action of the tides. In other places coral sands or loose fragments of corals, larger or smaller boulders, detached from lower parts of the living reef, are thrown upon its dying summits, and thus form the first accumulation of solid materials, rising permanently above low-water mark; collected sometimes in such quantities and at such heights as to remain dry, stretching their naked heads above high water.

In other places these accumulations of loose, dead materials have entirely covered the once living corals, as far as the eye can reach into the depth of the ocean: no sign of life is left, except perhaps here and there an isolated bunch of some of those species of corals which naturally grow scattered, or of those other organisms which congregate around or upon coral reefs; but the increase of the reef by the natural growth of the reef-building corals is at an end. Again, in other places, by the further accumulation of such loose materials, and the peculiar mode of aggregation which results from the action of the sea upon them, and which will be more fully explained hereafter, extensive islands are formed, ranging in the direction of the main land, which support them. Elsewhere we may find the whole extent of the reef thus covered, which, after a still more protracted accumulation, perhaps becomes united with some continental shore.

Now it must be obvious, that from a comparison of so many separate stages of the growth of a coral reef, a correct insight may be obtained into the process of its formation; and, indeed, in thus alluding to the different localities which came under our own observation, we have

already given a general history of its progress, which we now proceed to illustrate more in detail.

We would, however, first remark, that the extraordinary varieties which exist in the natural condition of different parts of the same reef, or of different reefs, when compared with each other, fully explain the discrepancies between the reports which have been obtained, respecting the reefs of Florida, prior to our investigations.

It had been stated that the reefs consisted solely of living corals; and, indeed, this report is true of the outer reef, which is called by all the inhabitants of Florida "*the reef*" *par excellence*, and is unfounded only with regard to those few islands which rise above the surface of the sea at Sand key and the Sambos. Others, who had noticed only the larger accumulations of coral fragments which occur on the shores of some of the islands forming part of the Florida reef, had reported the islands to be formed of coral rocks; while some who had, perhaps, observed the extensive excavations made around Key West, have told us only of the existence of oolitic and compact rocks, almost destitute of corals or other remains of animal life; and from still other localities comes the opinion, that the rocks consist of nothing but more or less disintegrated shells, cemented together. * * * *

Animal Life.

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This fullness and variety of animal life is particularly obvious within the boundaries of coral fields, the natural limits assigned to the growth of these animals being those in which animals of other classes range in greater profusion, and the coral reefs themselves also affording very favorable circumstances for the display of numerous living forms. Hence the extraordinary assemblage of all classes of animals upon the reef, where, besides those particular kinds of corals which contribute largely to its formation, we find upon it, or on the foundation from which it rises, a great variety of other corals, which, though too insignificant in size to take a conspicuous part in building up these extensive accumulations of organic lime-rock, add none the less their small share in the work, contributing especially to fill up the vacant spaces left by the more rapid and durable growth of the larger kinds. They are to the giants of the reef what the more slender parts are to the lords of the forest, adding the elegance and delicacy of slighter forms to the strength, power, and durability of their loftier companions.

But besides the stony corals, we find in the reef a great variety of soft polyps, either attached to the surface of dead corals, dead shells, or of the naked rock, or boring into the coral sand and mud.

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Such are different species of Arca, the date-fish among the Mollusca, and many worms, especially Serpula among articulates, the agency of which in the formation of the keys will be described hereafter. All these animals and plants contribute, more or less, to augment the mass of solid materials which is accumulating upon the reef, and increase its size. Not only are the hard parts of shells, echinoderms, worms, or their

broken fragments, heaped among the detritus of the corals, but occasionally even the bones of fishes and turtles, which are very numerous along the reef, may be found in the coral formations.

The decaying soft parts of all these animals undoubtedly have their influence upon the chemical process, by which the limestone particles of their solid frame are cemented together, in the formation of compact rocks. Upon this point we may expect further information from Professor Horsford, who is now submitting to chemical analysis all the variety of rocks and the solid stems of the different corals obtained in Florida. Respecting the relations of the solid and soft parts of the living coral, and their mode of growth, we would refer to a paper of ours now in press, to appear in the next volume of the Smithsonian Contributions to Knowledge. * * * * * *

The Keys.

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We see everywhere that the larger boulders and the coarser fragments have been the first to find a resting-place upon the dead reef; the minuter particles and coral sand, which are periodically washed away from its crest during heavy gales, never accumulating upon it till large boulders and more solid materials have collected to such an extent as to form sufficient protection for the more movable, looser fragments. This fact is beautifully illustrated by an accurate survey of Sand key, where a wide field of large boulders is partially laid bare at low water, presenting the appearance of an extensive key, with a low hill of minute materials, the product of some heavy gale, heaped upon the summit, against which the sea plays without disturbing it materially, even at high water, when it leaves in sight only a nucleus, as it were, for a greater accumulation of such loose materials which may in time cover the whole surface of the larger boulders. We have here in reality the same phenomenon which is observed upon all beaches, where larger materials have first accumulated on a shoal shore, being followed, in the course of time, by more minute fragments which have found a resting-place upon levels where the sea was powerless to increase the collection of coarser matter. In attempting to understand these formations, it must be remembered that the accumulation of the larger materials, collected at a certain level, may modify the action of the water at a subsequent period, thus producing a combination of substances, heaped unconformably upon each other. This is, in reality, the case throughout the whole main range of keys, which have been raised to their present level by the action of the tides and gales for ages past, the fragments of which they are composed having been thrown up at different periods, and overlying each other in such a manner as to present the same irregularity which is found in all drift stratification. Layers upon layers are seen resting unconformably, dipping in different directions so as to present all the modifications which may be observed in torrential stratification, each layer following, with more or less regularity, the course of the flood under which it has been accumulated.

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By a process, not yet fully understood, but to which we shall return hereafter, these loose collections are gradually cemented into solid rock, presenting the most diversified appearance, according to the substances of which it is composed. Then we find a coarse breccia, consisting of larger fragments of corals and shells, enclosing sometimes coral boulders; and this is the sort of rock which generally overlies the immediate surface of that portion of the keys which has been formed by the progress of the reef, growing *in situ.* Such rock was seen among the foundations of the new light-house at Sand key, where the large boulders are very numerous, and seem almost as fresh as if they had been lying on the spot but for a few years. It may be, indeed, that during the hurricane of 1846, the whole cap of the reef was renewed at that spot.

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A careful survey of the character of the rocks in the keys affords satisfactory evidence that they have been formed at whatever height they may rise, by the same action which is now going on upon the reef—that is, by the accumulation of loose materials above the water-level. That part of the keys which rises above the level of the water is, therefore, a sub-aerial and not a submarine accumulation of floating matter, thrown above high-water mark by the tempestuous action of the water. We insist upon the fact, that the keys furnish in themselves, by the internal structure of their rock, the fullest evidence that they have been formed above high-water mark by the action of gales and hurricanes, instead of having grown as a reef up to the water-level, and been subsequently raised to their present height. The evidence of this statement rests upon certain facts obtained from observation of the reef itself, at Sand key and the Sambos.

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Let us now return from this digression to the consideration of the keys themselves, under the different aspects which they present. We find, then, that some have more abrupt shores, being, as it were, narrow shelves with ragged edges, rising without a beach from deep water; these are undoubtedly such as were formed upon the narrowest part of the old reef. Others spread more uniformly, having an extensive beach, and dip gradually under the sea, presenting a gentle, submarine slope, covered with coral sand and mud; these were, no doubt, formed upon the broader parts of the reef, where it descends gently on both sides. Again, we find those which, though resembling the last in general appearance, may have more abrupt shores, owing to the denudation of parts of their earliest deposites. Occasionally we see that more recent layers have filled again such worn places, thus presenting, on a miniature scale, among the latest formations among layers which belong altogether to the present geological age, all the diversity of unconformable deposites which occur in former geological periods.

Coral Reefs.

After examining a growing coral reef, so full of life, so fresh in appearance, so free from heterogeneous materials, in which the corals adhere so firmly to the ground, or if they rise near the surface seem to

defy the violence of the ocean, standing uninjured amid the heaviest breakers, an observer cannot but wonder why, in the next reef, the summit of which begins to rise above the level of the water, the scene is so completely changed. Huge fragments of corals, large stems, broken at their base, gigantic boulders, like hemispheres of Porites, and Macandrina, lie scattered about in the greatest confusion—flung pell-mell among the fragments of more delicate forms, and heaped upon those vigorous madrepores which reach the surface of the sea.

The question at once arises, how is it that even the stoutest corals, resting with broad base upon the ground, and doubly secure from their spreading proportions, become so easily a prey to the action of the same sea which they met shortly before with such effectual resistance? The solution of this enigma is to be found in the mode of growth of the corals themselves. Living in communities, death begins first at the base or centre of the group, while the surface or tips still continue to grow, so that it resembles a dying centennial tree, rotten at the heart, but still apparently green and flourishing without, till the first heavy gale of wind snaps the hollow trunk, and betrays its decay. Again, innumerable boring animals establish themselves in the lifeless stem, piercing holes in all directions into its interior, like so many augers, dissolving its solid connexion with the ground, and even penetrating far into the living portion of these compact communities. The number of these boring animals is quite incredible, and they belong to different families of the animal kingdom: among the most active and powerful we would mention the date-fish, Lithodomus, several Saxicava, Petricola, Arca, and many worms, of which the Serpula is the largest and most destructive, inasmuch as it extends constantly through the living part of the coral stems, especially in Macandrina.

On the loose basis of a Macandrina, measuring less than two feet in diameter, we have counted not less than fifty holes of the date-fish—some large enough to admit a finger—besides hundreds of small holes made by worms.

But however efficient these boring animals may be in preparing the coral stems for decay, there is yet another agent, perhaps still more destructive. We allude to the minute boring-sponges, which penetrate them in all directions, until they appear at last completely rotten throughout. * * * * * * *

Ship Channel.

The broad channel extending the whole range of the reef, between the main keys and the outer reef, is rather uniform, having the same width throughout, with the exceptions of those few places where the reef widens, or the mud flats from the keys encroach upon it. Its narrowest passages are between Looe key and the Pine islands, between Pickle and French reefs, and between Key Rodrigues and Tavernier. It is also somewhat narrowed between Alligator reef and Indian key, and is widest off Key West. Its depth varies also slightly, being shoaler in its eastern range than to the west. The shallowest part is between Pickle reef and Key Rodriguez, and between Looe key and Pine islands.

But if we do not take into account those spots where the depth is reduced from local circumstances, we may say, that, as a whole, the ship channel begins to the east, with a depth of about two fathoms between Fowey rocks and Soldier key, increasing gradually thence, until it reaches three fathoms between Pacific reef and Old Rhodes, then becomes again slightly reduced between Carysfort reef and Key Largo; after which, with the exception of the shoals between Pickle reef and Key Rodriguez, it deepens again to three, four, five, or even six fathoms, until, between Looe key and Pine islands, it shoals once more to fourteen feet. Farther on, it increases again to five, six, and seven fathoms, the average depth between Key West and the reef being five or six fathoms; and still beyond, more towards the west, sinks to eight, nine, and ten fathoms between the western extremity of the Marquesas and the western end of the reef, where it spreads into the great depression separating the Tortugas from the Marquesas. The character of the bottom varies in different parts, as do also the living beings which it supports. Where it is the most shoal, as between Fowey rocks, Triumph reef, and Long reef, on one side, and Soldier key and the Ragged keys on the other, the bottom consists of coral sand, overgrown with what is called the country *grass*; that is to say, a variety of the limestone algæ, mingled with Gorgonia, among which rise a number of coral heads.

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To the west of Long reef, especially between Carysfort and Key Largo, the coral sand rises here and there, in the form of shoal sand-banks, intermixed with coral heads—an arrangement which is probably owing to the more rapid currents flowing in that part of the channel, which is precisely the turning-point of the direction of the reef. Such heads occur again about a mile and a half off Vermont key, half way between Key Tavernier and Indian key, outside of which Gorgonia and sponges are very abundant, upon a hard, white sand bottom. Similar heads are seen between Long key and Tennessee reef, and nearer the reef there are shoals of white coral sand, covered with Gorgonia; but farther west, off Duck key, the bottom becomes softer. Off Bahia Honda, again, it is rocky—that is, studded with large heads, surmounted with soft, muddy sand. This change in the character of the bottom is more obvious westward, where the heads are fewer and the bottom more generally muddy, or covered with finer-grained sand. For instance, hard sand is observed between Loggerhead key and Saddle bluff; but nearer the reef, as far as the American shoals, we have soft mud, with shoals and coral heads. Off Boca Chica, the channel way has also a bottom of soft coral mud, while shoals, with coral heads, may be traced for three-fourths of a mile along the shores, as, again, towards the Sambos, in a depth of from three to two fathoms. The softness of the bottom in the vicinity of Key West, considered in connexion with the scarcity of coral heads in that region, shows that a soft mud formation is unfavorable for the growth of corals; and, indeed, this holds also good for the flats north of the keys.

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The Main-land.

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A careful survey of all the varieties of rock occurring at Key West, as well as their peculiar superposition, had prepared us for a minute comparison between the keys and the main-land; but, nevertheless, we were no less surprised than delighted to find that the solid foundation of the main-land consisted of the same identical modifications of coral rocks which form the keys. Along all that part of the shore which was examined, as well as upon the shores of the Miami, we found everywhere the same coarse, oolitic rock, with cross-stratification, consisting of thin beds, dipping at various angles in different directions, precisely as we find it at the western extremity of Key West, excepting, perhaps, that the cross-stratification is here more prominent, the strata dipping more frequently in several directions within the same extent.

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Coast Survey.

But it may be asked, what is the practical use of such detailed descriptions of the coral reefs for the coast survey? We need only allude to the universal impression of the dangers arising to navigation, from the growth of such reefs, to satisfy the most skeptical that a minute knowledge of the extent and mode of formation of those belonging to our own shores must be of paramount importance, were it only with reference to the position of light-houses. But there is another subject connected with this investigation, which is not less momentous. It is well known that in the Pacific, coral reefs have been raised above the levels at which they were formed by the agency of the living animals, and also that in other localities, sometimes in close connexion with those just mentioned, the ground is subsiding. These changes have been so often observed, whenever coral reefs occur, that the idea of subsidence and upheaval is naturally connected with the features of coral reefs, and the question at once arises, whether the reefs on our shores are thus undergoing variations of level, independently of their natural growth. We have seen how extensive are the changes produced merely by the normal growth of the corals, and the facts accompanying their increase. It now remains for us to ascertain whether this growth has taken place, or does at present take place, upon ground which has changed or is now changing its relative level in reference to the sea.

The facts already described afford a sufficient answer to the question. We are satisfied that as far as coral formations have been observed upon the main-land of Florida, and within the present extent of the coral reefs, no change of the relative level has taken place either by subsidence or upheaval of the coral ground, and that all the modifications which the reef has presented at successive periods have been the natural consequence of the growth of reef-building corals, with the subsequent accumulation of their products in the manner described above.

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There is in reality but one way of accounting for this equality of level in the successive reefs; which is, to suppose that their loftiest ridges are the maximum height at which materials can be accumulated by the natural agency of gales, and we have sufficient evidence to justify the adoption of this view.

The fact that, at present, the highest tides during the most severe gales do not reach the level of the bluff summits along the shores of the main-land, or even that of the maximum height of Key Largo or Key West, does not invalidate this supposition, for when the shore bluffs of the main-land were formed, the ocean had full sweep over the ground now occupied by the reef and mud flats, which did not then exist; and when Key Largo and Key West attained their maximum height, the outer reef did not yet form a barrier, checking the violence of the Gulf Stream in that direction. But, even with the present obstruction, we have evidence of the occasional rise of the water to heights which fully justify our assumption, that even the highest ridges on the shores of the main-land and on the reef have been formed by the action of severe gales. For, in the year 1846, the water rose eight and a half feet above high-water mark at Key Vacas. Key West was entirely inundated during the same gale; and though that island is somewhat protected by the reef, even at present the rushes, driven upon it by the flood, may be seen among the trees and bushes, at a height almost equal to its loftiest summit. In 1841 the water rose ten feet above high-water mark at Cape Romaine, on the western shore of the peninsula.

These facts suffice to show that the explanation we have given of the formation of the reef is in accordance with the powers of the agencies to which it is ascribed, and, when taken in connexion with the peculiar arrangement of the materials of which they consist, seems to us to prove the justness of this view.

* * * * * * * * *

Physical Changes in the Gulf Stream.

There are several questions of the deepest scientific interest, which may be advanced by a due consideration of the facts observed upon the reefs of Florida. There we have a peninsula—a narrow, flat strip of land, projecting for about five degrees from the main land, between the Atlantic ocean and the Gulf of Mexico, and forming an effective barrier between the waters of the two seas, which otherwise, even by the change of a few feet in the relative level of the intervening peninsula, would communicate freely with one another; and this peninsula we now know to have been added to the continent, step by step, in a southerly direction.

We know that the time cannot be far behind us when the present reef, with its few keys, did not exist, and when the channel, therefore, was broader, and the Gulf Stream flowed directly along the main range of keys. We know, further, that at some earlier period the keys themselves were not yet formed, and that then the channel between Cuba and Florida was wider still, washing freely over the grounds now known as the mud flats, between the keys and the main land, and that there was then nothing to impede a free communication between the Gulf of

Mexico and the Atlantic ocean. The channel of the Gulf Stream was not only wider—it was also less shallow along its northern borders, for the whole extent of soundings south of the main land of Florida was an uncovered coral ground, upon which the deep-water species were just beginning to spread. But we may trace the change farther. There was a time when neither the southern bluffs of the continent, nor Long key within the everglades, nor even the everglades themselves, existed; when, therefore, the Gulf Stream had a broad communication with the Atlantic, and the southern shores of the United States extended in almost unbroken contiguity from west to east, from the shores of Texas and Louisiana to St. Augustine. At that time the gulf channel was, in reality, a broad bay, as broad as the gulf itself, destitute of all those obstructions which now cause the tropical current to follow such a circuitous course between the West India islands, through the Caribbean Seas, and around the peninsula of Florida. The influence which the Gulf Stream has upon the climate of the Atlantic is so well known, that its connexion with the changes which the current itself has undergone within a comparatively recent period cannot be overlooked. If it is true, as we have every reason to believe, that the temperature of the Gulf Stream, in connexion with the temperature of the southwesterly winds blowing obliquely across the Atlantic, modifies that of the western coast of Europe,—if it is true that the Gulf Stream and the southwest winds have an influence in determining the course of the isothermal lines upon the two sides of the Atlantic, and of raising beyond their normal altitude the mean annual temperatures of northwest Europe, then we may look to the physical changes which have occurred on the southeastern extremity of the North American continent for the cause, or at least a partial cause, of those changes of temperature which have taken place in the beginning of the present period, in those very northwestern portions of Europe which are now so much warmer than the corresponding latitudes on the American continent, and which, soon after the accumulation of the glacial drift, had as low mean annual temperatures as the coasts of Labrador, Nova Scotia, and New England in our day.

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Changes in ages to come.

Among the questions contained in your instructions, you ask whether the growth of coral reefs can be prevented, or the results remedied, which are so unfavorable to the safety of navigation. I may say that here, as in most cases where the operations of nature interfere with the designs of man, it is not by a direct intervention on our part that we may remedy the difficulties, but rather by a precise knowledge of their causes, which may enable us, if not to check, at least to avoid the evil consequences. I do not see the possibility of limiting in any way the extraordinary increase of corals, beyond the bounds which nature itself has assigned to their growth. We have seen how successfully several reefs have been formed, more or less parallel, within the limits of the peninsula of Florida, as well as beyond the main land. We have seen, also, how these parallel or concentric reefs have been gradually transformed into main land by the accumulation of coral sand and mud with other loose

materials, and also that the keys are now slowly annexed to the main land, by the same process. We may therefore safely infer, that, as far as the conditions exist for the formation of similar accumulations of loose materials, they will continue to occur, but they will never extend beyond the natural foundation from which a coral reef may rise; and as we now have sufficient evidence that this foundation is a sea-bottom, under from 12 to 20 fathoms, we may be satisfied that outside of the present outer reef, where the slope is steep, sinking rapidly to unfathomable depths, there is no opportunity for the growth of a new reef.

Here and there the reef may widen somewhat, towards the Gulf Stream, within those limits at which the depth does not exceed twenty fathoms, and from the knowledge we already possess of the soundings outside the reef, we know positively that this is nowhere a broad stream; we may therefore rest assured that the changes which are going on will chiefly consist in bringing up the reef, for its whole extent, to the surface of the water, with occasional intervening channels kept open by the currents, such as exist now between the keys; that this reef once matured, will be covered by coral debris, becoming transformed into a range of keys, similar to that which exists now inside of it; that the depth of the ship channel between the reef and the main range of keys will gradually lessen, and the channel itself be changed into mud flats, similar to those stretching now between the keys and the main land. In still more remote ages the present mud flats may become swamps, elevated above the reach of the tide-waters, like the everglades; and this process may perhaps be extended to the present ship channel. But unless some great revolution in nature modifies the present relative level between land and sea, it may safely be maintained that the present outer reef is the final southern boundary of the North American continent, and that the sooner a system of light-houses and signals is established along the whole reef, the better; for this is, after all, the shore which is to be lighted, and not the range of keys which is within the reef. In relation to the western range of keys, and the western extremity of the reef, we may expect, in course of time, to see the depression between the Marquesas and Tortugas gradually lessened by the increase of the reef, so that the westernmost group of islands may finally stand in as close connexion with the keys more to the west as they now bear to each other, the passage between them being reduced to as narrow a channel as Boca Grande, between the Marquesas and the Mangroves.

The shoals west of Cape Sable may, undoubtedly, also increase in extent westward; but how far the currents from the northwest may limit this accumulation, in connexion with the changes which the currents themselves may undergo by the increase of the keys to the west, it is beyond the power of human foresight to determine.

These practical results—for so we venture to call the general conclusions last presented—although they are purely scientific deductions from general principles, may satisfy the most obstinate supporters of the matter-of-fact side of all questions, of the advantages of scientific illustrations in the daily walks of life, and also justify the course which

has been followed with so much success by the Coast Survey, in combining the strictest scientific methods with its practical operation.

Respectfully submitted:

L. AGASSIZ.

Professor A. D. BACHE,
Superintendent of the Coast Survey.

APPENDIX No. 11.

List of Coast Survey maps, sketches, and preliminary charts, engraved and engraving.

1. LIST OF MAPS ENGRAVED.

No. 1.	New York bay and harbor and approaches	$\frac{1}{80000}$
2.	.. Do......do......do......do......No. 1	
3.	...Do......do......do......do......No. 2	
4.	...Do......do......do......do......No. 3	
5.	...Do......do......do......do......No. 4	$\frac{1}{30000}$
6.	...Do......do......do......do......No. 5	
7.	...Do......do......do......do......No. 6	
8.	Map of Delaware bay and river and approaches, No. 1	
9.	Map of Delaware bay and river and approaches, 2d engraved plate, No. 1	
10.	Map of Delaware bay and harbor and approaches, No. 2	$\frac{1}{80000}$
11.	Map of Delaware bay and harbor and approaches, No. 3	
12.	The harbor of New Bedford	$\frac{1}{40000}$
13.	The harbor of New London	$\frac{1}{20000}$
14.	Fisher's Island sound	$\frac{1}{40000}$
15.	Holmes' Hole and Tarpaulin Cove harbors	$\frac{1}{20000}$
16.	Oyster or Syossett bay	$\frac{1}{30000}$
17.	Little Egg harbor	$\frac{1}{30000}$
18.	Harbor of Annapolis	$\frac{1}{60000}$
19.	New Haven harbor	$\frac{1}{30000}$
20.	Harbor of Edgartown	$\frac{1}{20000}$
21.	Harbors of Black Rock and Bridgeport	$\frac{1}{20000}$
22.	Huntingdon bay	$\frac{1}{30000}$
23.	Nantucket harbor	$\frac{1}{20000}$
24.	Harbor of Sheffield and Cawkin's islands	$\frac{1}{20000}$
25.	Mouth of Chester river	$\frac{1}{20000}$
26.	Harbors of Captain's islands, east and west	$\frac{1}{20000}$
27.	Long Island sound, sheet No. 2	$\frac{1}{80000}$
28.	....Do........do......No. 3	$\frac{1}{80000}$
29.	Re-engraving lower sheet of the Delaware	$\frac{1}{80000}$
30.	Pasquotank river	$\frac{1}{60000}$
31.	Cat and Ship Island harbors	$\frac{1}{40000}$

32. Harbor of Hyannis........................... $\frac{1}{30000}$
33. South side Long Island, No. 1..................... $\frac{1}{80000}$
34. Hart and City islands and Sachem's Head.
35. Mobile entrance.
36. Chart of Hell Gate.
37. Richmond's Island harbor...................... $\frac{1}{20000}$

2. List of sketches and preliminary charts engraved.

No. 1. Sketch chart of Nantucket shoals, (3d edition)...... $\frac{1}{200000}$
2. ....Do.......Buttermilk channel, New York harbor $\frac{1}{5000}$
3. ....Do.......Cape Hatteras cove................ $\frac{1}{20000}$
4. ....Do.......Cape Hatteras inlet................ $\frac{1}{20000}$
5. ....Do.......Bull's Bay harbor .... $\frac{1}{40000}$
6. ....Do.......Beaufort harbor, North Carolina..... $\frac{1}{30000}$
7. ....Do.......St. Andrew's shoals, Georgia....... $\frac{1}{60000}$
8. ....Do.......Nantucket shoals, re-engraved and enlarged .... $\frac{1}{200000}$
9. Hatteras inlet, from re-survey..................... $\frac{1}{20000}$
10. Cape Canaveral shoals............................ $\frac{1}{60000}$
11. Seacoast Maryland and Delaware .... $\frac{1}{200000}$
12. Hatteras shoals.................................. $\frac{1}{120000}$
13–15. Reconnaissance chart (McArthur's) western coast.... $\frac{1}{120000}$
16. Richmond's island .... $\frac{1}{20000}$
17. Sketch chart of Nantucket shoals................. $\frac{1}{200000}$
18–20. Second edition McArthur's chart western coast.
21. Hatteras inlet, re-survey......................... $\frac{1}{20000}$
22–26. Five diagram maps Cat Island tides.
27. Reconnaissance of Mosquito inlet................. $\frac{1}{40000}$
28. ......Do....... Horn Island pass .... $\frac{1}{30000}$
29. Sketch of Point Conception....................... $\frac{1}{40000}$
30. Sketch of Point Pinos and bay of Monterey........ $\frac{1}{20000}$
31. Sketch of Mare Island straits .... $\frac{1}{30000}$
32. Current chart Boston harbor.
33. Reconnaissance of Cedar Keys.................... $\frac{1}{300000}$
34. ......Do.......Delta of the Mississippi.......... $\frac{1}{60000}$
35. ......Do.......Pass Christian .... $\frac{1}{40000}$
36. Preliminary sketch of Galveston bay.............. $\frac{1}{300000}$
37. Sketch of Aransas pass........................... $\frac{1}{30000}$
38. Preliminary chart of Trinidad bay................ $\frac{1}{20000}$
39. Entrance of the Columbia river................... $\frac{1}{200000}$
40. Cape Hancock, or Disappointment................. $\frac{1}{20000}$
41. Holmes' Hole.
42–48. Seven maps of progress and geographical positions for annual report.

3. List of maps engraving.

No. 1. General chart of the coast......................... $\frac{1}{400000}$
2. No. 1, Long Island sound .... $\frac{1}{80000}$
3. No. 1, Chesapeake bay............................ $\frac{1}{80000}$

No. 4. Patapsco river .... $\frac{1}{60000}$
5. No. 2, south side Long Island .... $\frac{1}{80000}$
6. No. 1, eastern series .... $\frac{1}{80000}$
7. Boston harbor .... $\frac{1}{40000}$
8. Muskeget channel .... $\frac{1}{60000}$
9. Charleston harbor .... $\frac{1}{30000}$
10. Key West .... $\frac{1}{50000}$
11. Connecticut river .... $\frac{1}{20000}$
12. No. 2, Mobile bay .... $\frac{1}{80000}$

4. List of sketches and preliminary charts engraving.

No. 1. Seacoast of Delaware and Maryland; plate enlarged by electrotyping additional engraving, work of hydrographic parties .... $\frac{1}{200000}$
2. Beaufort harbor .... $\frac{1}{30000}$
3. Preliminary chart of Humboldt bay .... $\frac{1}{30000}$
4. Preliminary chart of the harbor of Key West .... $\frac{1}{100000}$
5. Sketch of the entrance of the Chesapeake .... $\frac{1}{100000}$
6. Re-engraving Nantucket shoals .... $\frac{1}{200000}$
7. Chart of the harbor of San Diego.
8. Entrance of San Francisco .... $\frac{1}{400000}$
9. Savannah river, vicinity of Savannah .... $\frac{1}{20000}$
10. Savannah entrance .... $\frac{1}{30000}$
11. Mobile bay .... $\frac{1}{200000}$
12. Bull's bay, re-engraving .... $\frac{1}{40000}$
13. Entrance to Columbia river .... $\frac{1}{40000}$
14–16. New edition of McArthur's chart western coast.
17. Point Pinos, view.
18. View of mouth of Columbia river.
19–26. Eight maps of progress and geographical positions.

APPENDIX No. 12.

List of geographical positions determined by the United States Coast Survey.

The present list contains those geographical positions determined by the Coast Survey of the United States which may be supposed to be useful to the navigator, the geographer, and the surveyor. They embrace all the trigonometrical points of the coast survey, determined up to July, 1850, and also positions of a number of prominent objects determined by means of the plane-table.

For the purposes of the survey, the coast of the United States is divided into eleven sections, in all of which the work is carried on simultaneously. The survey being in different stages of progress in the several sections, and new results being added from year to year to those here given, the same divisions have been adopted in this publication. The several sections are defined as follows:

Sec. I. From Passamaquoddy bay to Point Judith.
Sec. II. From Point Judith to Cape Henlopen.
Sec. III. From Cape Henlopen to Cape Henry.

Sec. IV. From Cape Henry to Cape Fear.
Sec. V. From Cape Fear to the St. Mary's river.
Sec. VI. From the St. Mary's river to St. Joseph's bay.
Sec. VII. From St. Joseph's bay to Mobile bay.
Sec. VIII. From Mobile bay to Vermilion bay.
Sec. IX. From Vermilion bay to the Rio Grande.
Sec. X. Coast of California, San Diego bay, to 42d parallel.
Sec. XI. Coast of Oregon, 42d to 49th parallel.

The tables give the latitudes and longitudes of the trigonometrical points in each section, and their relative azimuths, or bearings, and distances. The manner in which these data have been obtained may be briefly explained here:

In each section a base line of from five to ten miles in length is measured with all possible accuracy. A series of triangles, deriving the length of their sides from this base, is then established along the coast, by the measurement of the angles between the intervisible stations. In this primary series the triangles are made as large as the nature of the country will permit, because the liability to error increases with the number of triangles.

On the bases furnished by the sides of the primary triangles, a secondary triangulation is next established, extending along the coast, and over the smaller bays and sounds, and determining a large number of points at distances of a few miles apart.

The distances between the points thus determined, as given in the tables, are liable to an average error of about one foot in six miles, until a final adjustment between the base lines shall have been made.

As, on the completion of the primary triangulation in each section, the several series form one connected chain, the different bases afford verifications of each other, and of the triangulation connecting them. The first three sections are thus connected at present.

Observations for latitude and azimuth are made at a number of stations of the primary triangulation in each section. The differences of latitude, longitude, and azimuth between these and other stations are then computed, under the supposition that the earth is a spheroid of revolution of the following dimensions, which are those determined by *Bessel* from all the measurements made to the present time, viz:

Equatorial radius	=6377397.15 metres.
Polar radius	=6356079.11 "
Eccentricity	= 0.0816968

It has been found that the differences of latitude and longitude, as computed in this manner from the distance and azimuth between two stations, and which are called *geodetic*, differ from those obtained by astronomical observations at the several stations, by quantities which are greater than the errors of the observations. Such disagreements are due to local irregularities in the figure and density of the earth, and the error resulting from them in the determinations of latitude and of the meridian plane is designated as *station error*. It amounts, according to the results obtained at present, to between one and two seconds of arc in the eastern section of the survey, and to about half a second in the sections south of the Delaware.

In order to eliminate the influence of station errors on the general

results, observations are made at a number of stations; the results are referred to a central station by means of the geodetic differences, and the mean of all is used for the computation of the positions given in the tables. The geographical positions must therefore be considered as liable to future changes, from the accumulation of new observations, and the final discussion of all the results obtained.

The *differences of longitude* are obtained, as has been stated, by computation, from the distances, latitudes and azimuths of the triangulation. In adding up these differences, from station to station, an accumulation of the unavoidable errors is highly probable. They are checked, however, by differences of longitude, determined by means of the electro-magnetic telegraph, in every section where the introduction of the latter makes it practicable.

SEATON STATION, in Washington city, has been selected as the centre for the telegraphic differences of longitude. The Sections at present connected by telegraph are Sections I, II, III and V. The first three being also connected by triangulation, the check on the geodetic differences of longitude is here obtained, and the agreement is very close.

The longitudes from Greenwich depend upon that of Cambridge observatory, as determined by chronometric differences between Liverpool and Cambridge, and by occultations, eclipses and moon culminations, observed at various observatories in the United States, and referred to Cambridge by means of telegraphic differences.

The following statement shows the result up to the present time:

Longitude of Cambridge from Greenwich.

	h.	m.	s.
By moon culminations observed at Cambridge, Hudson, Ohio, Wilkes' observatory, and National Observatory	4	44	28.4
By eclipses and occultations at Cambridge, Brooklyn, Philadelphia, and Wilkes' observatory............	4	44	29.6
By chronometric differences.........................	4	44	30.1

The longitude adopted for the present is 4h. 44m. 29.5s., or 71° 07′ 22″.50.

In Sections IV, VI, VIII, IX, and X, the longitudes are counted from some central station in each. Sections IV and VIII will soon be connected by telegraph with Seaton station and Cambridge. In Sections VI and IX the longitudes from Greenwich will for some time depend upon less exact determinations. For the present we have the following data:

	°	′	″
Sec. IV. Stevenson's Point, west of Greenwich.........	76	10	43.5
Sec. VI. Cape Florida...........ditto.................	80	05	00
" " Sand key..............ditto.................	*81	52	43
Secs. VIII and IX. Fort Morgan, Mobile Point..........	88	00	25
Sec. X. Coast Survey observatory, near San Diego....	*117	13	22

Explanation of the tables.

The first column on the left contains the name of the several stations or triangulation points. Their general locality is indicated by the

* Corrected from data to November, 1852.

heading at the top of the page, by means of which they will be readily found on the sketches accompanying the tables. Sub-headings in the first column indicate the locality more minutely where it is practicable.

The stations are generally either prominent objects of permanence, such as spires, light-houses, beacons, &c., or they are the points on prominent hills, capes, or points of land, where signals have been erected for the purpose of the survey, and which are marked on the ground. In a small number of cases in the first three Sections, but much more frequently in the southern Sections, where settlements on the coast are sparse, and few permanent objects are to be found, the stations have no other distinguishing mark than the signal erected on the spot; and after its decay, the mark left on the ground, to designate the station point. The latter generally consists of posts or stones set around the point; while the centre of the station is designated by an earthen cone or glass bottle buried under the surface of the ground and marked on top by a stone or post. Where the station is on a rock, a copper bolt, or a hole filled with lead or sulphur, will be found to designate the exact spot.

The sketches showing the configuration of the land, as well as the relative positions of the stations, no great difficulty will be experienced in finding the latter, when desired for local surveys or reference. In any case where minute descriptions of particular points are required, they can be had by application addressed to the Coast Survey office.

The second and third columns contain the latitudes and longitudes of the stations named.

The fourth column contains the azimuth of the line joining the station named in the first column to that named in the fifth; that is to say, the angle which that line makes with the meridian of the former station, reckoned from south around by west, through the whole circle. The sixth column gives the back azimuth of the same line, or the angle which it makes with the meridian of the latter station, reckoned as before; the difference between the azimuths in the fourth and those in the sixth columns being 180°, less the inclination of the meridians at the two stations.

The seventh, eighth, and ninth columns give the distances, in metres, yards, and miles, between the stations named in the first and fifth columns. The relation of the metre to the yard used in obtaining these results, is—

1 metre=1.0935696 yard, or 39.36850 United States standard inches.

For each station the azimuths and distances to two other stations are given. In every case the lines so given have actually been observed.

In each section the stations of the primary triangulation are given in a separate table, in which all the distances and azimuths observed are given. Whenever these primary stations afterwards occur in the columns of the general table, they are distinguished by being printed in small capitals.

Those points which are marked with an asterisk have been determined by means of the plane-table; their positions are not as accurate as those of the trigonometrical points, and are liable to be in error about three metres, or ten feet.

United States Coast Survey.—Geographical Positions. Section I.—Primary Stations. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Mass. Base { North End....	42 03 04.52	71 12 03.88	....	....	....	....	....	....
Mass. Base { South End....	41 54 47.89	71 17 55.15	207 47 11.0	North Base..................	27 51 05.9	17326.1	18947.3	10.76
Beaconpole..................	41 59 40.37	71 26 40.36	252 34 17.8	North Base..................	72 44 04.5	21122.7	23099.1	13.11
			306 41 03.2	South Base..................	126 46 54.3	15091.1	16503.2	9.38
Great Meadow Hill..........	41 52 43.01	71 12 41.29	123 44 55.9	Beaconpole Hill..............	303 35 35.1	23223.4	25396.4	14.43
			182 34 09.4	North Base..................	2 34 34.3	19192.8	20988.7	11.92
Spencer Hill................	41 40 41.07	71 29 19.79	185 37 35.5	Beaconpole Hill..............	5 59 21.9	35338.8	38645.4	21.96
			225 54 01.5	Great Meadow Hill..........	46 05 06.8	32056.5	35056.0	19.92
Copecut Hill................	41 43 15.08	71 03 15.56	133 18 13.6	Beaconpole Hill..............	313 02 33.2	44424.6	48581.4	27.60
			143 21 13.1	Great Meadow Hill..........	323 14 56.0	21851.7	23896.4	13.58
			82 39 37.9	Spencer Hill..................	262 22 17.3	36474.8	39887.7	22.66
Pocasset Hill................	41 39 07.23	71 11 11.33	150 41 02.5	Beaconpole Hill..............	330 30 43.0	43665.9	47751.7	27.13
			235 09 31.9	Copecut Hill..................	55 14 48.3	13397.7	14651.3	8.32
			96 39 33.3	Spencer Hill..................	276 27 29.7	25343.7	27715.1	15.75
			175 17 22.7	Great Meadow Hill..........	355 16 22.8	25251.7	27614.5	15.69
McSparran Hill..............	41 29 44.71	71 27 03.81	180 33 39.8	Beaconpole Hill..............	0 33 46.5	55396.8	60580.2	34.42
			232 46 47.4	Copecut Hill..................	53 02 35.0	41452.8	45331.5	25.76
			231 43 41.4	Pocasset Hill................	51 54 13.4	28069.8	30696.3	17.44
			171 10 29.7	Spencer Hill..................	351 08 50.4	20490.8	22408.1	12.73
Quaker Hill..................	41 34 55.17	71 14 57.32	118 12 25.1	Spencer Hill..................	298 02 52.2	22634.1	24751.9	14.06
			60 26 12.5	McSparran Hill..............	240 18 10.8	19370.7	21183.2	12.04
			226 24 36.5	Copecut Hill..................	46 32 22.9	22392.9	24488.2	13.91
			169 33 29.5	Beaconpole Hill..............	340 25 41.1	48607.4	53155.6	30.20
			213 54 42.8	Pocasset Hill................	33 57 12.9	9371.9	10248.8	5.82
			185 26 20.2	Great Meadow Hill..........	5 27 50.8	33091.6	36188.0	20.56

United States Coast Survey.—Geographical Positions. Section I.—Primary Stations. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Cuttyhunk	41 25 12.65	70 55 41.50	123 56 39.6	Quaker Hill	303 43 53.7	32270.1	35289.6	20.05
			101 02 57.4	McSparran Hill	280 42 11.5	44479.3	48641.2	27.64
			162 33 25.3	Copecut Hill	342 28 24.0	35008.5	38284.2	21.75
Indian Hill	41 25 44.51	70 40 19.45	135 36 03.3	Copecut Hill	315 20 50.1	45457.4	49710.8	28.24
			87 27 21.3	Cuttyhunk Hill	267 17 11.2	21430.4	23435.6	13.32
Manomet Hill	41 55 36.61	70 35 06.87	59 44 29.0	Copecut Hill	239 25 42.9	45184.9	49412.8	28.08
			7 28 44.5	Indian Hill	187 25 16.6	55754.3	60971.2	34.64
			96 18 51.2	Beaconpole Hill	275 44 22.8	71625.4	78327.4	44.51
Shootflying Hill	41 41 05.18	70 20 28.37	44 17 19.4	Indian Hill	224 04 09.3	39501.0	43306.4	24.61
			143 03 18.9	Manomet Hill	322 53 33.3	33672.7	36823.4	20.92
Blue Hill	42 12 41.92	71 06 31.61	305 57 30.7	Manomet Hill	126 18 33.6	53642.2	58661.5	33.33
			12 58 42.7	Great Meadow Hill	192 54 35.5	37951.2	41502.3	23.58
			49 08 49.0	Beaconpole Hill	228 55 18.9	36776.9	40218.1	22.85
			355 14 53.9	Copecut Hill	175 17 05.0	54693.7	59811.4	33.98
Thompson's Hill	42 36 40.03	70 43 27.99	351 21 41.2	Manomet Hill	171 27 18.4	76863.6	84055.7	47.76
			35 37 01.1	Blue Hill	215 21 27.9	54491.2	59589.9	33.86
Wachusett	42 29 18.82	71 52 53.34	326 32 27.9	Beaconpole Hill	146 50 05.5	65657.3	71800.9	40.80
			295 31 36.9	Blue Hill	116 02 50.9	70700.0	77315.4	43.93
			261 27 23.0	Thompson's Hill	82 14 29.0	95990.1	104971.9	59.64
Holt's Hill	42 38 26.13	71 06 03.86	45 55.6	Blue Hill	180 45 36.9	47647.2	52105.5	29.60
			275 55 16.7	Thompson's Hill	96 10 34.9	31066.0	33972.8	19.30
Unkonoonue	42 58 58.04	71 34 58.57	335 24 29.1	Blue Hill	155 43 44.4	94076.8	102879.6	58.45
			24 06 11.4	Wachusett	203 54 01.9	60092.8	65715.7	37.34

United States Coast Survey.—Geographical Positions. Section I.—Primary Stations. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Unkonoonuc—Continued	42 58 58.04	71 34 58.57	300 09 31.2	Thompson's Hill	120 44 31.0	81460.7	89083.0	50.61
			313 48 08.9	Holt's Hill	134 07 47.8	54750.9	59873.9	34.02
Agamenticus	43 13 22.90	70 41 11.75	70 12 56.0	Unkonoonuc	249 36 11.1	77684.9	84953.9	48.27
			27 44 48.1	Holt's Hill	207 27 51.7	73007.4	79838.7	45.36
			2 36 56.7	Thompson's Hill	182 35 24.0	68040.8	74407.4	42.28
Patuccawa	43 07 11.92	71 11 30.37	325 47 58.6	Thompson's Hill	146 07 03.1	68212.3	74594.9	42.38
			352 02 52.8	Holt's Hill	172 06 34.9	53762.1	58792.6	33.40
			254 15 13.4	Agamenticus	74 35 57.6	42638.0	46627.6	26.49
			64 34 32.8	Unkonoonuc	244 18 31.1	35322.0	38627.3	21.95
			39 02 42.5	Wachusett	218 34 35.4	90006.6	98428.5	55.93
Gunstock	43 31 02.64	71 21 50.51	16 44 17.3	Unkonoonuc	196 35 17.3	61990.5	67790.9	38.52
			342 22 46.4	Patuccawa	162 29 51.9	46306.8	50639.7	28.77
			300 32 51.5	Agamenticus	121 00 46.2	63900.7	69879.9	39.70
			332 25 20.0	Thompson's Hill	152 51 32.1	113350.7	123956.9	70.43
Ossipee	43 35 17.23	70 44 06.54	35 35 53.5	Patuccawa	215 17 05.0	63832.1	69804.8	39.66
			354 26 42.5	Agamenticus	174 28 42.7	40747.8	44560.5	25.32
Mount Independence	43 45 32.18	70 18 53.04	60 54 21.4	Ossipee	240 36 56.2	38850.1	42485.3	24.14
			72 46 35.8	Gunstock	252 03 08,9	88809.1	97119.0	55.18
			26 55 49.0	Agamenticus	206 40 27.6	66699.8	72940.9	41.44
NARRAGANSETT BAY.								
McSparran Hill	41 29 44.71	71 27 03.81	....	....	....	....	....	....
Quaker Hill	41 34 55.16	71 14 57.34	60 26 12	McSparran Hill	240 18 11	19370,7	21183.2	12.04

United States Coast Survey.—Geographical Positions. Section I.—Narragansett Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Pocasset	41 39 07.20	71 11 11.36	51 54 13	McSparran Hill	231 43 41	28069.8	30696.3	17.44
			33 57 13	Quaker Hill	213 54 43	9371.9	10248.8	5.82
East Rock, Seconnet	41 27 02.41	71 11 17.31	102 55 51	McSparran Hill	282 45 24	22522.3	24629.7	13.99
			160 44 22	Quaker Hill	340 41 56	15449.5	16895.1	9.60
Whitman	41 40 31.71	71 26 58.43	21 26	McSparran Hill	180 21 23	19958.6	21826.1	12.40
			301 48 55	Quaker Hill	121 56 56	19655.2	21494.3	12.21
Mount Hope	41 40 23.95	71 14 05.17	90 50 15	Whitman	270 41 41	17885.4	19559.0	11.11
			42 30 52	McSparran Hill	222 22 15	26721.2	29221.5	16.60
Nootas Hill	41 32 10.78	71 07 04.82	31 38 29	East Rock	211 35 41	11170.7	12216.0	6.94
			114 53 22	Quaker Hill	294 48 09	12065.5	13194.5	7.50
Kinnicut	41 47 45.72	71 21 36.51	29 05 03	Whitman	209 01 29	15315.9	16749.0	9.52
			322 31 56	Mount Hope	142 36 57	17160.7	18766.4	10.66
Arnold	41 45 12.32	71 23 20.79	30 10 48	Whitman	210 08 24	10011.8	10948.6	6.22
			304 39 25	Mount Hope	125 45 35	15622.3	17084.1	9.71
Fort Independence	41 47 32.29	71 23 12.42	21 56 40	Whitman	201 54 10	13985.8	15294.5	8.69
			316 12 26	Mount Hope	136 18 31	18289.5	20000.9	11.36
Pomham	41 46 40.02	71 21 07.06	35 35 01	Whitman	215 31 07	13964.6	15271.3	8.68
			319 54 55	Mount Hope	139 59 35	15153.9	16571.9	9.42
Pomham Beacon	41 46 32.98	71 22 06.12	34 44 00	Arnold	214 43 10	3027.7	3311.0	1.88
			140 05 13	Fort Independence	320 04 28	2385.7	2608.9	1.48
Pawtuxet Beacon	41 45 33.40	71 22 29.99	61 01 05	Arnold	241 00 31	1341.7	1467.2	0.83

United States Coast Survey.—Geographical Positions. Section I.—Narragansett Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Pawtuxet Beacon—Contin'd.	41 45 33.40	71 22 29.99	165 02 43	Fort Independence	345 02 15	3795.5	4151.7	2.37
Pawtuxet Church	41 45 57.21	71 23 09.53	27 48 08	Whitman	207 45 36	11349.4	12411.3	7.05
			309 12 09	Mount Hope	129 18 11	16247.3	17767.5	10.09
Friends' College	41 49 58.45	71 23 35.38	15 02 05	Whitman	194 59 50	18101.2	19794.9	11.24
			323 19 33	Mount Hope	143 25 52	22081.3	24147.4	13.71
College Hill	41 50 16.71	71 23 39.69	166 33 15	Beaconpole	346 31 15	17880.2	19553.3	11.11
			253 23 08	Great Meadow Hill	73 10 27	15841.7	17324.0	9.84
Providence Congregational Church.	41 49 10.78	71 24 29.83	12 06 45	Whitman	192 05 07	16376.4	17908.7	10.17
			318 20 16	Mount Hope	138 27 12	21734.3	23768.0	13.50
Providence Unitarian Church	41 49 25.78	71 23 59 03	14 08 00	Whitman	194 06 06	16949.3	18535.2	10.53
			320 33 52	Mount Hope	140 40 32	21623.8	23647.1	13.43
Providence Baptist Church	41 49 36.78	71 24 11.16	12 57 21	Whitman	192 55 30	17252.5	18866.8	10.71
			313 48 49	Kinnicut	133 50 32	4947.6	5410.5	3.07
Swanzey Belfry	41 45 01.06	71 13 09.85	66 37 20	Whitman	246 28 08	20876.4	22829.8	12.97
			8 30 40	Mount Hope	188 30 03	8643.5	9452.2	5.37
Neutacoukanut	41 48 38.95	71 27 42.15	280 58 29	Kinnicut	101 02 32	8597.9	9402.4	5.34
			316 32 35	Arnold	136 35 30	8777.4	9598.6	5.45
Batty's Farm	41 45 32.75	71 24 14.86	221 41 41	Kinnicut	41 43 26	5495.3	6009.5	3.41
			140 13 03	Neutacoukanut	320 10 45	7476.9	8176.5	4.64
Prospect Hill	41 49 42.43	71 23 59.89	69 07 12	Neutacoukanut	249 04 43	5490.0	6003.7	3.41
			344 43 34	Fort Independence	164 44 06	4161.3	4550.7	2.58

United States Coast Survey.—Geographical Positions. Section I.—Narragansett Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Bullock's Neck	41 44 40.74	71 21 06.71	151 15 45	Fort Independence	331 14 21	6036.3	6601.1	3.75
			107 28 11	Arnold	287 26 42	3247.2	3551.0	2.01
Rocky Point	41 41 27.51	71 21 29.05	19 42 18	McSparran Hill	199 38 36	23023.7	25178.0	14.30
			323 07 42	Quaker Hill	143 12 02	15121.9	16536.8	9.39
Nayat Light	41 43 27.91	71 20 01.31	21 06 13	McSparran Hill	201 01 32	27213.1	29759.4	16.90
			335 59 54	Quaker Hill	156 03 16	17310.7	18930.4	10.75
Warren Spire	41 43 46.29	71 16 41.73	29 04 29	McSparran Hill	208 57 35	29687.7	32465.5	18.44
			67 13 22	Whitman	247 06 32	15468.8	16916.2	9.61
Prince	41 44 32.45	71 18 35.21	320 49 08	Mount Hope	146 52 08	9885.9	10810.9	6.14
			57 29 22	Whitman	237 23 47	13800.7	15092.0	8.57
High Rocks	41 37 45.36	71 25 47.84	162 21 12	Whitman	342 29 25	5385.1	5889.0	3.34
			253 11 11	Mount Hope	73 18 58	16977.2	18565.7	10.54
Pojack	41 39 02.74	71 24 06.99	13 23 58	McSparran Hill	193 22 01	17694.3	19349.9	10.99
			259 44 34	Mount Hope	79 51 14	14145.0	15468.6	8.78
Warwick Neck	41 41 18.94	71 22 28.75	34 58 21	High Rocks	214 56 09	8038.4	8790.5	4.99
			278 14 22	Mount Hope	98 19 56	11768.5	12869.7	7.31
Warwick Light	41 39 59.26	71 22 22.36	266 09 54	Mount Hope	86 15 25	11525.0	12603.4	7.16
			312 16 50	Quaker Hill	132 21 46	13932.5	15235.2	8.65
Warwick Beacon	41 39 22.82	71 23 15.21	16 33 25	McSparran Hill	196 39 53	18602.9	20343.6	11.56
			112 23 16	Whitman	292 20 48	5583.2	6105.6	3.47
Patience Island	41 39 31.27	71 21 03.57	260 25 53	Mount Hope	80 30 31	9813.6	10731.6	6.10

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Patience Island—Continued	41 39 31.27	71 21 03.57	315 05 53	Quaker Hill	135 09 57	12017.9	13142.4	7.47
Pappoose Squaw	41 39 13.01	71 17 41.50	246 21 40	Mount Hope	66 24 04	5461.8	5972.9	3.39
			334 26 33	Quaker Hill	154 28 21	8815.6	9640.5	5.48
Rum Stick	41 42 21.86	71 17 46.73	71 57 18	Rocky Point	251 54 50	5406.8	5912.7	3.36
			344 06 09	Quaker Hill	164 08 02	14327.0	15667.6	8.90
Pine Hill	41 37 58.27	71 20 14.80	242 14 43	Mount Hope	62 18 49	9660.6	10564.5	6.00
			307 30 34	Quaker Hill	127 34 05	9270.5	10137.9	5.76
Hope Island	41 36 08.10	71 21 38.64	137 43 35	Whitman	317 40 01	10994.9	12023.7	6.83
			233 00 37	Mount Hope	53 05 38	13130.4	14359.0	8.13
Prudence	41 36 22.22	71 18 21.57	122 48 29	Whitman	302 42 45	14222.1	15552.9	8.84
			218 29 05	Mount Hope	38 31 56	9529.2	10420.9	5.92
Hog Island	41 38 38.19	71 16 29.52	31 44 21	Prudence	211 43 07	4931.5	5392.9	3.06
			342 45 04	Quaker Hill	162 46 05	7203.4	7877.4	4.48
Castle Island Beacon	41 39 11.78	71 16 51.13	239 52 33	Mount Hope	59 54 23	4437.8	4853.1	2.76
			341 34 42	Quaker Hill	161 35 58	8343.1	9123.8	5.18
Bristol Court-house	41 40 10.48	71 16 04.64	261 26 20	Mount Hope	81 27 39	2794.4	3055.9	1.74
			350 53 20	Quaker Hill	170 54 05	9850.9	10772.7	6.12
Wickford Hill	41 34 28.32	71 27 41.76	267 15 08	Quaker Hill	87 23 36	17725.8	19384.4	11.01
			354 15 12	McSparran Hill	174 15 38	8792.9	9615.7	5.46
Wickford Spire	41 34 21.18	71 26 39.08	266 14 43	Quaker Hill	86 22 28	16288.7	17812.8	10.12
			3 50 42	McSparran Hill	183 50 26	8547.6	9347.4	5.31

United States Coast Survey.—Geographical Positions. Section I.—Narragansett Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Wickford Light	41 34 13.70	71 26 01.70	9 50 52	McSparran Hill	189 50 11	8421.5	9209.5	5.23
			101 01 27	Wickford Hill	281 00 21	2361.5	2582.5	1.47
Batty	41 32 11.01	71 22 15.27	157 01 35	Whitman	336 58 27	16779.0	18349.0	10.43
			216 41 07	Mount Hope	36 46 33	18973.0	20748.3	11.79
Quonsett	41 35 24.36	71 24 12.75	236 37 42	Mount Hope	56 44 26	16826.4	18400.9	10.45
			335 27 32	Batty	155 28 51	6555.9	7169.3	4.07
Fox Island	41 33 14.01	71 24 43.53	169 55 00	High Rocks	349 54 17	8501.9	9297.4	5.28
			228 01 59	Mount Hope	48 09 03	19856.4	21714.4	12.34
Spindle	41 34 24.42	71 24 42.73	20 46 03	McSparran Hill	200 44 29	9227.2	10090.5	5.73
			91 40 43	Wickford Hill	271 38 44	4148.9	4537.1	2.57
Prudence South	41 34 42.24	71 19 11.96	100 35 45	Quonsett	280 32 21	7086.3	7749.3	4.40
			42 20 01	Batty	222 17 59	6308.4	6898.6	3.91
Slate Hill	41 32 18.77	71 15 38.62	191 13 00	Quaker Hill	11 13 28	4918.3	5378.5	3.06
			271 08 04	Nootas Hill	91 13 44	11912.7	13027.4	7.40
Conanicut Neck	41 34 22.64	71 21 58.91	233 44 36	Prudence	53 46 59	6239.3	6823.1	3.87
			293 24 28	Slate Hill	113 28 39	9604.1	10502.7	5.96
Gould Island	41 32 02.06	71 20 21.03	199 00 49	Prudence	19 02 08	8488.8	9283.1	5.72
			265 28 08	Slate Hill	85 31 14	6565.9	7180.2	4.07
Miantonomy	41 30 34.80	71 18 16.44	82 50 44	McSparran Hill	262 44 55	12326.7	13480.1	7.65
			146 45 45	Whitman	326 39 58	22026.1	24087.0	13.68
Hazard	41 28 20.99	71 18 56.59	102 54 57	McSparran Hill	282 49 34	11592.6	12677.3	7.20
			192 42 45	Miantonomy	12 43 11	4231.6	4627.5	2.62

United States Coast Survey.—Geographical Positions. Section I.—Narragansett Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Half Way Rock	41 33 47.69	71 19 37.34	342 29 28	Miantonomy	162 39 22	6235.8	6819.2	3.87
			50 51 37	Batty	230 49 52	4719.0	5160.7	2.93
Rose Island	41 29 45.96	71 20 13.44	240 56 22	Miantonomy	60 57 39	3103.9	3394.3	1.92
			325 46 08	Hazard	145 46 59	3169.5	3466.1	1.96
Poor House Belfry	41 30 24.62	71 19 22.31	258 22 00	Miantonomy	78 22 44	1559.8	1705.7	0.96
			351 06 16	Hazard	171 06 33	3859.9	4220.9	2.39
Goat Island Light	41 29 33.83	71 19 18.11	91 49 15	McSparran Hill	271 44 06	10805.9	11817.0	6.71
			347 28 36	Hazard	167 28 50	2301.7	2517.1	1.42
Fort Adams, (flag staff)	41 28 45.25	71 19 53.25	213 35 41	Miantonomy	33 36 43	4057.6	4437.2	2.52
			299 38 44	Hazard	119 39 22	1512.7	1654.2	0.93
Dumplin	41 28 43.42	71 21 46.89	234 50 21	Miantonomy	54 52 40	5969.0	6527.5	3.70
			279 55 14	Hazard	99 57 08	4010.9	4386.2	2.49
Telegraph	41 27 45.56	71 19 50.64	110 07 47	McSparran Hill	290 02 59	10699.3	11700.4	6.64
			202 42 17	Miantonomy	22 43 19	5659.5	6189.0	3.51
Castle Hill	41 27 50.76	71 21 07.81	113 05 29	McSparran Hill	293 01 24	8975.1	9814.9	5.57
			218 08 02	Miantonomy	38 09 56	6435.0	7037.1	3.99
Newport Spire	41 29 12.23	71 18 28.70	34 00 06	Beacon Hill. (Sec. II)	213 49 04	41721.9	45625.8	25.92
			82 00 36	Tiff's Hill. (Sec. II)	261 51 42	18888.1	20655.5	11.74
Beaver Tail Light	41 26 54.58	71 23 38.45	137 47 00	McSparran Hill	317 44 43	7087.9	7751.1	4.40
			227 41 13	Miantonomy	47 44 46	10097.0	11041.8	6.27
Meeting House Hill	41 26 43.09	71 28 13.00	17 55 48	Beacon Hill. (Sec. II)	197 51 12	31550.9	34503.1	19.60
			110 46 48	Tiff's Hill. (Sec. II)	290 44 20	5504.6	6019.7	3.42

United States Coast Survey.—Geographical Positions. Section I.—Narragansett Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Boston Neck	41 28 16.85	71 25 44.49	50 00 13	Meeting House Hill	229 58 35	4821.3	5272.4	2.99
			145 50 34	McSparran Hill	325 49 40	3276.1	3582.6	2.04
Tiverton Steeple	41 37 28.04	71 12 29.85	157 53 21	Mount Hope	337 52 18	5857.2	6405.3	3.64
			35 54 52	Quaker Hill	215 53 14	5822.1	6366.9	3.62
Fall River	41 42 37.07	71 08 24.45	62 29 49	Mount Hope	242 26 02	8884.1	9715.4	5.52
			30 48 41	Pocasset Hill	210 46 50	7536.1	8241.3	4.68
Slade	41 43 39.04	71 09 48.02	44 40 11	Mount Hope	224 37 20	8459.4	9251.0	5.26
			314 41 47	Fall River	134 42 43	2717.5	2977.8	1.69
Somerset Meeting House	41 44 09.35	71 09 45.84	40 47 19	Mount Hope	220 44 26	9180.7	10039.8	5.70
			326 32 08	Fall River	146 33 02	3411.9	3731.2	2.12
Blackbeard	41 40 26.68	71 10 37.76	89 00 21	Mount Hope	268 58 03	4797.5	5246.4	2.98
			17 33 45	Pocasset Hill	197 33 22	2571.1	2811.7	1.60
Mattapoiset	41 42 38.29	71 12 30.70	27 47 44	Mount Hope	207 46 41	4685.0	5123.4	2.91
			327 14 25	Blackbeard	147 15 39	4827.2	5278.9	3.00
Toweset	41 41 57.04	71 14 12.70	356 31 42	Mount Hope	176 31 47	2877.5	3146.8	1.79
			299 15 57	Blackbeard	119 18 29	5698.3	6231.5	3.54
Butts	41 35 53.65	71 14 45.51	188 11 00	Mount Hope	8 11 26	6553.9	7167.2	4.07
			79 02 56	Prudence	259 00 31	5095.3	5572.1	3.17
Anthony	41 38 44.17	71 12 57.59	153 04 36	Mount Hope	333 03 50	3452.3	3775.3	2.15
			36 14 29	Butts	216 13 08	4226.2	4621.6	2.63
Cornell	41 37 16.75	71 08 55.43	62 29 55	Quaker Hill	242 25 54	9449.0	10333.1	5.87
			344 47 27	Nootas Hill	164 48 39	9780.2	10695.3	6.08

United States Coast Survey.—Geographical Positions. Section I.—Narragansett Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Barker	41 38 20.80	71 11 45.59	139 38 41	Mount Hope	319 37 08	4985.6	5452.1	3.10
			34 59 45	Quaker Hill	214 57 38	7742.2	8466.6	4.81
Wings	41 35 21.01	71 10 49.28	154 08 15	Mount Hope	334 06 05	10386.3	11358.2	6.45
			82 07 04	Quaker Hill	262 04 19	5799.2	6341.8	3.60
High Hill	41 32 48.80	71 12 38.42	140 28 29	Quaker Hill	320 26 57	5054.4	5527.3	3.14
			208 17 23	Wings	28 18 36	5333.0	5832.0	3.31
Windmill	41 32 31.37	71 11 29.39	132 39 20	Quaker Hill	312 37 01	6548.0	7160.7	4.06
			86 10 11	Slate Hill	266 07 24	5789.2	6330.9	3.59
Gibbs	41 29 34.43	71 16 08 15	304 46 16	East Rock	124 49 29	8218.2	8987.1	5.10
			249 00 05	Nootas Hill	69 06 05	13490.8	14753.1	8.38
Church's Point	41 29 57.86	71 12 02.90	348 55 52	East Rock	168 56 22	5515.9	6032.0	3.42
			82 46 31	Gibbs	262 43 47	5733.6	6270.1	3.56
Little Compton	41 31 10.15	71 10 39.64	249 23 51	Nootas Hill	69 26 14	5321.2	5819.1	3.30
			6 31 07	East Rock	186 30 42	7692.4	8412.1	4.77
Little Compton Belfry	41 30 31.37	71 09 57.27	86 38 03	McSparran Hill	266 26 42	23848.4	26079.8	14.81
			162 35 12	Mount Hope	342 32 26	19160.0	20952.8	11.90
Simmons	41 29 30.05	71 09 13.13	210 57 58	Nootas Hill	30 59 23	5783.7	6324.8	3.59
			147 00 02	Little Compton	326 59 04	3682.4	4026.9	2.28
Quicksand	41 29 59.44	71 06 51.10	175 32 25	Nootas Hill	355 32 16	4064.4	4444.7	2.52
			74 37 24	Simmons	254 35 49	3416.5	3735.8	2.12
Eldridge	41 31 43.89	71 04 47.15	104 36 15	Nootas Hill	284 34 44	3295.2	3603.5	2.04
			46 12 55	East Rock	226 08 35	12540.7	14714.1	7.79

United States Coast Survey.—Geographical Positions. Section I.—Buzzard's Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Almy	41 30 40.04	71 01 28.68	109 47 45	Nootas Hill	289 44 02	8277.9	9052.4	5.14
			63 52 06	East Rock	243 45 35	15214.9	16638.5	9.45
BUZZARD'S BAY.								
CUTTYHUNK	41 25 12.65	70 55 41.50	123 56 39.6	Quaker Hill	303 43 53.7	32270.1	35289.6	20.05
			101 02 57.4	McSparran Hill	280 42 11.5	44479.3	48641.2	27.64
Mishaum Point	41 30 53.89	70 56 55.31	350 45 10	Cuttyhunk	170 45 58	10664.9	11662.8	6.63
			70 25 28	East Rock	250 15 57	21232.9	23219.7	13.19
Gooseberry Neck	41 29 17.85	71 01 58.49	247 07 22	Mishaum Point	67 10 43	7629.3	8343.2	4.74
			310 48 40	Cuttyhunk	130 52 50	11565.1	12647.3	7.19
Cuttyhunk Light	41 24 50.07	70 56 39.04	101 23 58	East Rock	281 14 17	20793.5	22739.1	12.92
			133 10 39	Nootas Hill	313 03 44	19889.3	21750.4	12.36
Prospect Hill, Martha's Vineyard.	41 21 54.58	70 44 29.83	219 19 40	Indian Hill	39 22 26	9171.9	10030.2	5.70
			111 26 46	Cuttyhunk	291 19 22	16755.8	18323.6	10.41
Naushon	41 29 22.81	70 44 12.16	64 18 40	Cuttyhunk	244 11 04	17761.4	19423.3	11.04
			321 15 07	Indian Hill	141 17 41	8631.9	9439.6	5.36
West Island	41 34 54.42	70 48 59.62	326 53 49	Naushon	146 56 59	12207.9	13350.2	7.59
			27 28 50	Cuttyhunk	207 24 24	20222.1	22114.3	12.57
Nashawena	41 25 28.73	70 51 45.44	84 51 10	Cuttyhunk	264 48 34	5502.9	6017.8	3.42
			192 24 42	West Island	12 26 32	17868.9	19540.9	11.10
Tarpaulin Cove Light	41 28 05.69	70 45 07.52	208 21 15	Naushon	28 21 52	2703.5	2956.5	1.68
			156 54 44	West Island	336 52 10	13708.5	14991.2	8.52

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United States Coast Survey.—Geographical Positions. Section I.—Buzzard's Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Naushon, SW.	41 26 59.60	70 46 58.80	117 37 58	Mishaum Point	297 31 23	15611.0	17071.7	9.70
			169 11 01	West Island	349 09 41	14912.5	16307.9	9.26
Pasque	41 26 55.60	70 49 43.25	239 22 48	Naushon	59 26 27	8923.6	9758.5	5.54
			321 52 43	Prospect Hill	141 56 10	11798.4	12902.3	7.33
Penikese Island	41 26 55.93	70 55 05.76	14 35 52	Cuttyhunk	194 35 30	3292.4	3600.5	2.05
			160 54 53	Mishaum Point	340 53 42	7768.0	8494.9	4.83
Round Hill	41 32 22.58	70 55 29.47	1 12 21	Cuttyhunk	181 12 13	13265.4	14506.6	8.24
			242 33 10	West Island	62 37 31	10174.8	11126.9	6.32
Round Hill Light	41 32 15.66	70 54 57.93	47 10 38	Mishaum Point	227 09 16	3710.4	4057.6	2.31
			239 25 50	West Island	59 29 48	9638.8	10540.7	5.99
Pamanset River	41 31 38.43	70 59 07.98	294 03 33	Mishaum Point	114 05 01	3368.7	3683.9	2.09
			254 55 52	Round Hill	74 58 17	5244.5	5735.3	3.26
Sconticut Neck	41 35 00.46	70 50 59.24	19 52 31	Cuttyhunk	199 49 24	19277.9	21081.7	11.98
			47 21 44	Mishaum Point	227 17 48	11222.0	12272.0	6.97
Clark's Point	41 35 31.96	70 53 42.57	8 13 29	Cuttyhunk	188 12 10	19302.3	21108.5	11.99
			279 59 37	West Island	100 02 45	6654.6	7277.3	4.14
Clark's Point Light	41 35 32.07	70 53 42.77	22 55 55	Round Hill	202 54 43	6346.5	6940.4	3.94
			280 00 56	West Island	100 04 04	6660.0	7283.2	4.14
Padanaram (gray spire)	41 35 17.92	70 56 06.96	350 52 20	Round Hill	170 52 44	5478.2	5990.8	3.40
			262 36 40	Clark's Point	82 38 16	3371.9	3687.5	2.10
Padanaram	41 35 37.07	70 56 14.62	278 45 39	Sconticut Neck	98 49 08	7390.5	8082.0	4.59
			350 06 18	Round Hill	170 06 48	6090.0	6659.9	3.78

United States Coast Survey.—Geographical Positions. Section I.—Buzzard's Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
New Bedford, (beacon)......	41 36 31.43	70 53 07.60	23 48 54	Clark's Point...............	203 48 31	2005.3	2192.9	1.25
			313 20 31	Sconticut Neck	133 21 56	4087.7	4470.2	2.54
New Bedford, (fort)	41 37 24.87	70 53 49.25	357 27 16	Clark's Point	177 27 20	3486.6	3812.8	2.17
			318 31 13	Sconticut Neck	138 33 06	5944.7	6500.9	3.69
New Bedford, (Baptist spire).	41 38 10.17	70 55 15.86	314 32 40	Sconticut Neck	134 35 29	8338.6	9118.8	5.18
			9 43 13	Mishaum Point.............	189 42 06	13654.6	14932.3	8.48
Fair Haven, (black spire) ...	41 38 07.62	70 53 57.73	11 17 52	Round Hill................	191 16 49	10853.4	11868.9	6.74
			324 23 31	Sconticut Neck	144 25 30	7099.9	7764.3	4.41
Swift's Hill................	41 34 00.27	70 38 09.44	21 33 10	Prospect Hill...............	201 28 58	24062.7	26314.2	14.95
			77 40 42	Mishaum..................	257 28 15	26719.1	29219.2	16.60
Angelica Point.............	41 33 26.80	70 45 34.16	308 34 03	Swift's Hill................	128 38 57	13176.7	14409.6	8.18
			36 00 00	West Island................	215 57 44	8096.1	8853.6	5.03
West Island, 2.............	41 35 22.92	70 48 43.66	22 46 55	West Island................	202 46 40	953.1	1042.2	0.59
			217 41 59	Angelica Point.............	37 44 05	7171.0	7841.9	4.46
Sampson's Hill, (Martha's Vineyard.)	41 22 39.58	70 28 41.13	109 26 39	Indian Hill................	289 18 49	17192.4	18801.0	10.68
			198 28 16	Shootflying Hill	18 33 43	35966.9	39332.1	22.34
Falmouth	41 35 50.92	70 36 44.21	14 57 25	Indian Hill	194 55 03	19360.7	21172.3	12.03
			335 17 57	Sampson's Hill.............	155 23 18	26859.6	29372.9	16.69
Falmouth Spire	41 33 12.81	70 36 51.16	19 16 31	Indian Hill................	199 14 13	14648.6	16019.2	9.10
			27 00 19	Prospect Hill...............	206 55 16	23474.1	25670.6	14.59
Hog Island Harbor.........	41 36 13.65	70 38 35.74	80 27 19	West Island................	260 20 25	14652.5	16023.5	9.10
			351 34 34	Swift's Hill................	171 34 50	4159.6	4548.8	2.58

United States Coast Survey.—Geographical Positions. ***Section I.—Buzzard's Bay.*** *Sketch A.*

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Mattapoiset Neck	41 37 44.40	70 47 50.12	17 04 00	West Island................	197 03 14	5484.6	5997.8	3.41
			297 09 32	Swift's Hill................	117 15 57	15119.3	16534.0	9.39
Mattapoiset, (gray spire)....	41 39 41.77	70 48 51.12	1 16 21	West Island................	181 16 15	8866.2	9695.8	5.51
			296 53 29	Angelica Point.............	116 55 40	5110.3	5588.5	3.18
Ned's Point Light	41 39 01.15	70 47 24.92	345 55 48	Naushon	165 57 56	18391.0	20111.8	11.43
			276 00 17	Wild Harbor	96 06 01	12032.3	13158.1	7.48
Wild Harbor	41 38 20.02	70 38 47.81	65 56 04	West Island................	245 49 18	15519.3	16971.4	9.64
			91 18 44	Angelica Point.............	271 14 14	9405.7	10285.8	5.84
Wenaumet Neck	41 40 55.99	70 39 19.77	62 02 58	Angelica Point.............	241 58 49	9807.6	10725.2	6.09
			351 15 44	Wild Harbor	171 16 05	4867.9	5323.4	3.02
Sippican Neck	41 40 33.78	70 42 36.84	46 20 21	Angelica Point.............	226 18 23	5671.9	6202.7	3.52
			261 25 55	Wenaumet Neck............	81 28 06	4608.9	5040.1	2.86
Sippican Church	41 42 07.77	70 45 26.71	326 01 25	Swift's Hill................	146 06 16	18126.0	19822.1	11.26
			284 35 36	Wenaumet Neck............	104 39 40	8768.5	9589.0	5.45
Scraggy Neck..............	41 39 57.13	70 38 54.33	162 03 09	Wenaumet Neck............	342 02 52	1908.7	2087.3	1.19
			357 06 56	Wild Harbor	177 07 04	2999.3	3279.9	1.86
Bird Island Light...........	41 40 07.50	70 42 42.93	51 54 48	Angelica Point.............	231 52 54	5034.3	5505.3	3.13
			189 51 21	Sippican Neck	9 51 25	822.7	899.7	0.51
Charles' Neck	41 40 19.45	70 44 23.85	25 05 23	Angelica Point.............	205 04 36	3836.8	4195.8	2.38
			259 52 10	Sippican Neck..............	79 53 21	2514.2	2749.5	1.56
Great Hill.................	41 42 31.13	70 42 59.22	25 26 32	Angelica Point.............	205 24 49	8345.6	9126.5	5.19
			300 01 30	Wenaumet Neck............	120 03 56	5861.7	6410.2	3.64

United States Coast Survey.—Geographical Positions. Section I.—Buzzard's Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Tempe's Knob	41 42 56.31	70 39 27.60	357 12 14	Wenaumet Neck	177 12 20	3716.1	4063.8	2.31
			80 59 52	Great Hill	260 57 31	4952.8	5416.2	3.08
Indian Neck	41 43 31.14	70 41 05.82	54 46 52	Great Hill	234 45 37	3208.9	3509.2	1.99
			332 51 57	Wenaumet Neck	152 53 08	5377.4	5880.6	3.34
Cromeset Neck	41 43 39.61	70 42 59.35	275 40 51	Indian Neck	95 42 07	2636.7	2883.4	1.64
			285 14 53	Tempe's Knob	105 17 12	5072.8	5547.5	3.15
Long Neck	41 44 18.07	70 38 24.15	62 35 51	Great Hill	242 32 48	7162.1	7832.3	4.45
			11 39 23	Wenaumet Neck	191 38 46	6365.1	6960.7	3.96
Back River Harbor	41 43 16.44	70 36 29.22	125 36 32	Long Neck	305 35 14	3266.3	3571.9	2.03
			42 19 05	Wenaumet Neck	222 17 11	5858.0	6406.2	3.64
Wareham, (Baptist spire)	41 45 25.05	70 42 42.41	6 51 36	Cromeset Neck	186 51 25	3276.6	3583.2	2.04
			294 40 27	Back River Harbor	114 44 36	9491.4	10379.5	5.90
Monumet Church	41 44 30.31	70 35 28.45	84 42 16	Long Neck	264 40 19	4077.1	4458.6	2.53
			31 38 54	Back River Harbor	211 38 15	2676.7	2927.2	1.66
Pine Hill	41 42 28.99	70 33 37.35	19 25 02	Falmouth	199 22 58	13017.7	14235.8	8.09
			175 08 51	Manomet	355 07 51	24385.6	26667.4	15.15
Pocasset Spire	41 41 39.34	70 35 56.86	32 45 37	Wild Harbor	212 43 43	7309.9	7993.9	4.54
			66 04 30	Angelica Point	245 58 06	14614.7	15982.2	9.08
South Pocasset Spire	41 40 34.12	70 36 01.58	132 39 28	Tempe's Knob	312 37 11	6475.4	7081.3	4.02
			42 55 07	Wild Harbor	222 53 22	5647.4	6175.9	3.51
North Falmouth Spire	41 38 31.16	70 36 46.02	83 03 35	Wild Harbor	263 02 21	2838.4	3104.0	1.76
			115 01 22	Sippican Neck	294 57 29	8053.9	9791.7	5.56

United States Coast Survey.—Geographical Positions. Section I.—Martha's Vineyard. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Wood's Hole	41 31 36.59	70 39 20.32	58 39 03	Naushon	238 35 49	7936.0	8667.7	4.92
			7 12 07	Indian Hill	187 11 28	10946.8	11971.1	6.80
Naushon, Northeast	41 30 33.51	70 42 27.68	223 09 16	Swift's Hill	43 12 07	8746.5	9564.9	5.44
			131 34 52	West Island	311 30 32	12135.9	13271.4	7.54
Nobska Light	41 30 55.03	70 38 58.94	11 02 35	Indian Hill	191 01 42	9759.1	10672.3	6.06
			90 01 07	Mishaum	269 49 15	24956.0	27291.1	15.51
MARTHA'S VINEYARD.								
Indian Hill	41 25 44.51	70 40 19.45	135 36 03.3	Copecut	315 20 50.1	45457.4	49710.8	28.24
			87 27 21.3	Cuttyhunk	267 17 11.2	21430.4	23435.6	13.32
Prospect Hill	41 21 54.58	70 44 29.83	219 19 40	Indian Hill	39 22 26	9171.9	10030.2	5.70
			111 26 46	Cuttyhunk	291 19 22	16755.8	18323.6	10.41
No Man's Land	41 15 09.43	70 48 27.98	203 52 54	Prospect Hill	23 55 31	13670.5	14949.7	8.49
			151 35 49	Cuttyhunk	331 31 03	21161.6	23141.6	13.15
Molasha Hill	41 20 26.76	70 48 17.27	242 50 42	Prospect Hill	62 53 12	5940.3	6496.1	3.69
			170 33 19	Pasque	350 32 22	12159.8	13297.6	7.56
Gay Head	41 20 48.05	70 49 52.76	181 06 57	Pasque	1 07 02	11340.0	12401.1	7.04
			254 40 37	Prospect Hill	74 44 10	7781.2	8509.3	4.83
Gay Head Light	41 20 51.86	70 49 47.33	180 29 01	Pasque	0 29 04	11220.8	12270.8	6.97
			255 16 40	Prospect Hill	75 20 10	7628.8	8342.6	4.74
Sampson's Hill	41 22 39.58	70 28 41.13	109 26 30	Indian Hill	289 18 49	17192.4	18801.0	10.68
			198 28 16	Shootflying Hill	18 33 43	35966.9	39332.1	22.34

United States Coast Survey.—Geographical Positions. Section 1.—Martha's Vineyard. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Nashaquitsa Cliff	41 19 58.06	70 44 06.08	171 16 09	Prospect Hill	351 15 53	3635.8	3976.0	2.26
			256 51 55	Sampson's Hill	77 02 06	22067.9	24132.8	13.71
Watcha Pond	41 20 49.93	70 36 17.07	252 15 06	Sampson's Hill	72 20 07	11122.8	12163.5	6.91
			148 14 21	Indian Hill	328 11 41	10689.7	11690.0	6.64
Herring Pond	41 20 45.09	70 31 12.86	126 04 55	Indian Hill	305 58 54	15701.4	17170.6	9.76
			224 55 46	Sampson's Hill	44 57 26	4990.4	5457.4	3.10
Edgartown	41 23 49.52	70 32 34.66	78 01 09	Prospect Hill	257 53 17	16989.8	18579.6	10.55
			108 14 04	Indian Hill	288 08 57	11360.5	12423.5	7.06
Edgartown Spire	41 23 16.41	70 30 34.51	82 39 59	Prospect Hill	262 30 47	19571.8	21403.2	12.16
			108 38 36	Indian Hill	288 32 09	14331.9	15672.9	8.90
Cape Poge Light	41 25 13.79	70 26 44.37	76 09 07	Prospect Hill	255 57 21	25500.5	27886.6	15.85
			92 56 27	Indian Hill	272 47 28	18947.7	20720.7	11.80
Holmes' Hole Spire	41 27 12.93	70 35 58.90	109 20 28	Naushon	289 15 01	12125.4	13259.9	7.53
			150 08 38	Wood's Hole	330 06 25	9379.9	10257.5	5.82
West Chop	41 28 52.07	70 35 56.75	46 31 13	Indian Hill	226 28 19	8404.8	9191.2	5.52
			94 45 41	Naushon	274 40 13	11530.6	12609.5	7.16
West Chop Light	41 28 55.43	70 35 49.48	94 11 16	Naushon	274 05 43	11690.8	12784.7	7.26
			135 29 49	Wood's Hole	315 27 26	6972.7	7625.1	4.33
East Chop	41 28 02.59	70 33 29.62	65 54 52	Indian Hill	245 50 21	10421.8	11397.0	6.48
			326 03 44	Sampson's Hill	146 06 55	12005.8	13129.2	7.46
East Chop Telegraph	41 28 02.51	70 33 27.72	99 28 03	Naushon	279 20 56	15153.8	16571.8	9.42
			128 57 20	Wood's Hole	308 53 26	10511.1	11494.7	6.53

United States Coast Survey.—Geographical Positions. Section I.—Nantucket Sound. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Bowman's Point	41 32 34.27	70 35 44.56	26 47 35	Indian Hill	206 44 33	14157.2	15481.9	8.80
			331 47 11	Sampson's Hill	151 51 51	20810.0	22757.2	12.93
Davis' Neck	41 32 52.21	70 33 27.35	35 57 39	Indian Hill	215 53 06	16292.0	17816.5	10.12
			340 36 38	Sampson's Hill	160 39 48	20030.9	21905.2	12.45
Monaunt Hill	41 33 03.32	70 32 11.18	39 57 46	Indian Hill	219 52 22	17648.8	19300.2	10.97
			345 45 59	Sampson's Hill	165 48 18	19848.4	21705.6	12.33
Succonoset	41 33 29.26	70 28 14.95	49 35 48	Indian Hill	229 27 48	22087.5	24154.3	13.72
			77 21 27	Wood's Hole	257 14 07	15807.7	17286.6	9.82
NANTUCKET SOUND.								
Hyannis	41 37 51.17	70 18 05.25	27 43 49	Sampson's Hill	207 36 47	31751.2	34722.1	19.73
			81 57 16	Falmouth	261 44 53	26168.0	28616.3	16.26
Nantucket Cliff	41 17 33.56	70 06 32.29	108 00 24	Indian Hill	287 38 04	49485.7	54116.0	30.75
			156 04 16	Shootflying Hill	335 55 02	47667.9	52128.1	29.62
Great Point Light	41 23 22.10	70 02 24.55	28 12 04	Nantucket Cliff	208 09 20	12197.1	13338.4	7.58
			88 05 38	Sampson's Hill	267 48 16	36651.0	40080.4	22.77
Sankaty Head	41 16 57.66	69 57 31.89	95 04 58	Nantucket Cliff	274 59 01	12621.9	13802.9	7.84
			150 10 57	Great Point Light	330 07 44	13672.0	14951.3	8.50
Squam Head	41 19 31.24	69 59 34.52	50 59 21	Great Point Light	330 57 29	8144.3	8906.4	5.06
			69 33 15	Nantucket Cliff	249 28 39	10372.9	11343.5	6.45
Gibbs' Pond	41 16 51.38	70 01 09.94	267 47 50	Sankaty Head	87 50 14	5077.2	5552.2	3.15
			99 52 05	Nantucket Cliff	279 48 32	7611.8	8324.0	4.73

United States Coast Survey.—Geographical Positions. Section 1.—Nantucket Sound. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Forked Pond	41 14 13.68	70 00 42.12	221 10 51	Sankaty Head	41 12 57	6722.3	7351.4	4.18
			172 25 19	Gibbs' Pond	352 25 01	4907.6	5366.8	3.05
Coatue	41 19 04.36	70 02 35.55	298 55 42	Sankaty Head	118 59 02	8073.0	8828.4	5.02
			334 05 29	Gibbs' Pond	154 06 26	4559.8	4986.5	2.83
Weeweeder Pond	41 14 33.01	70 05 16.42	233 19 40	Gibbs' Pond	53 22 23	7150.7	7819.8	4.44
			275 18 33	Forked Pond	95 21 34	6414.4	7014.5	3.99
Windmill Range	41 16 37.95	70 06 28.09	298 53 40	Forked Pond	118 57 28	9200.8	10061.7	5.72
			336 35 24	Weeweeder Pond	156 36 11	4199.4	4592.4	2.61
Nantucket (Mitchell's house.)	41 16 57.19	70 05 39.00	62 32 34	Windmill Range	242 32 02	1286.8	1407.3	0.80
			132 08 09	Nantucket Cliff	312 07 34	1671.9	1828.3	1.04
Nantucket, (South towered church.)	41 16 54.45	70 05 36.39	353 51 24	Weeweeder Pond	173 51 35	4388.1	4798.7	2.73
			269 27 12	Sankaty Head	89 32 32	11278.5	12333.8	7.01
Sankaty Head Light	41 16 59.13	69 57 35.09	150 21 27	Great Point Light	330 18 16	13595.7	14867.8	8.45
			89 18 27	Nantucket, (South towered church.)	269 13 09	11204.4	12252.8	6.96
Clark's Cove	41 15 18.19	70 10 21.69	281 04 08	Weeweeder Pond	101 07 29	7242.1	7919.7	4.50
			245 37 58	Windmill Range	65 40 32	5967.6	6526.0	3.71
North Pond	41 17 36.14	70 10 10.69	3 26 44	Clark's Cove	183 26 37	4262.8	4661.7	2.65
			289 05 41	Windmill Range	109 08 08	5481.5	5994.4	3.41
Further Creek	41 16 37.44	70 13 45.40	297 15 31	Clark's Cove	117 17 45	5334.1	5833.3	3.31
			250 03 32	North Pond	70 05 54	5313.6	5810.8	3.30
Muskeget Island	41 20 11.83	70 17 37.04	287 27 57	Nantucket Cliff	107 35 16	16212.2	17729.2	10.07
			294 47 07	North Pond	114 52 02	11437.8	12508.0	7.11

United States Coast Survey.—Geographical Positions. Section 1.—Nantucket Sound. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Tuckanuck Telegraph	41 18 12.24	70 14 47.02	275 52 30	Nantucket Cliff	95 57 57	11570.6	12653.2	7.19
			113 06 57	Sampson's Hill	292 57 46	21071.7	23043.4	13.09
Nantucket Light Boat	41 26 44.00	70 17 05.00	319 02 ..	Nantucket Cliff	139 10 ..	22461.0	24563.0	13.96
			176 07 ..	Hyannis	356 07 ..	20627.0	22557.0	12.82
Cotuit Neck	41 35 28.97	70 26 22.88	249 06 42	Hyannis	69 12 12	12327.4	13480.8	7.66
			7 42 27	Sampson's Hill	187 40 55	23949.1	26190.0	14.88
Hamblin's Hill	41 41 47.77	70 23 52.27	58 25 29	Falmouth	238 16 56	20981.0	22944.2	13.04
			312 14 51	Hyannis	132 18 42	10849.7	11864.9	6.74
Marston Mills	41 38 47.53	70 24 35.73	233 23 08	Shootflying Hill	53 25 51	7124.0	7790.5	4.42
			190 12 46	Hamblin's Hill	10 13 15	5650.6	6179.3	3.51
Osterville	41 37 49.98	70 22 35.74	269 38 26	Hyannis	89 41 26	6260.5	6846.3	3.89
			166 26 23	Hamblin's Hill	346 25 32	7546.2	8252.3	4.68
Osterville Spire	41 37 39.91	70 22 47.92	266 56 10	Hyannis	86 59 18	6551.5	7164.5	4.07
			80 13 33	Falmouth	260 04 18	19650.3	21489.0	12.21
Osterville Point	41 36 59.96	70 21 49.30	253 02 17	Hyannis	73 04 46	5421.3	5928.6	3.37
			145 08 36	Osterville	325 08 05	1880.7	2056.7	1.17
Collier's Ledge	41 35 46.18	70 20 45.29	146 12 20	Osterville	326 11 07	4596.0	5026.1	2.86
			223 50 40	Hyannis	43 52 26	5347.2	5847.5	3.32
Bishop and Clerks	41 34 25.27	70 14 40.56	143 17 20	Hyannis	323 15 04	7924.8	8666.3	4.92
			119 53 51	Osterville	299 48 35	12686.0	13873.0	7.88
Point Gammon Light	41 36 32.80	70 15 38.81	59 54 45	Indian Hill	239 38 24	39726.7	43443.9	24.68
			35 17 30	Sampson's Hill	215 08 50	31461.8	34405.7	19.55

United States Coast Survey.—Geographical Positions. Section I.—Cape Cod and Cape Cod Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ″ ′		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Point Gammon	41 37 02.81	70 15 17.91	207 35 11	German Hill	27 37 13	9156.3	10013.1	5.69
			126 30 15	Hamblin's Hill	306 24 33	14796.0	16180.5	9.19
CAPE COD AND CAPE COD BAY.								
German's Hill	41 41 25.89	70 12 14.49	50 48 57	Hyannis	230 45 04	10472.9	11452.8	6.50
			92 28 13	Hamblin's Hill	272 20 29	16148.0	17658.9	10.03
Centreville Church	41 38 42.80	70 20 27.95	179 51 32	Shootflying Hill	359 51 31	4393.0	4804.1	2.73
			295 44 27	Hyannis	115 46 02	3664.4	4007.3	2.28
Hyannis Spire	41 39 03.62	70 16 53 83	127 06 00	Shootflying Hill	307 03 37	6220.5	6802.6	3.86
			36 30 27	Hyannis	216 29 40	2779.9	3040.0	1.73
West Yarmouth Spire	41 38 56.94	70 13 25.26	112 03 16	Shootflying Hill	291 58 35	10555.6	11543.3	6.56
			72 38 30	Hyannis	252 35 25	6789.0	7424.3	4.22
Bass River	41 38 36.31	70 11 50.64	59 00 11	Point Gammon	238 57 53	5596.6	6120.3	3.48
			173 58 42	German's Hill	353 58 26	5259.4	5751.5	3.27
Bass Hole	41 42 47.89	70 13 54.07	70 52 42	Shootflying Hill	250 48 20	9649.7	10552.6	6.00
			317 41 48	German's Hill	137 42 54	3421.1	3741.2	2.13
Barnstable Light	41 43 19.01	70 16 31.92	52 57 39	Shootflying Hill	232 55 02	6849.9	7490.8	4.26
			74 35 21	Hamblin's Hill	254 30 28	10561.7	11550.0	6.56
Barnstable, (cupola)	41 42 13.09	70 18 41.83	49 36 39	Shootflying Hill	229 36 29	3233.4	3536.0	2.01
			83 49 28	Hamblin's Hill	263 46 01	7220.4	7896.0	4.49
Barnstable (Unitarian spire)	41 42 00.30	70 17 36.28	66 52 38	Shootflying Hill	246 50 44	4326.8	4731.7	2.69
			87 29 40	Hamblin's Hill	267 25 30	8702.6	9516.9	5.41

United States Coast Survey.—Geographical Positions. Section I.—Cape Cod and Cape Cod Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Barnstable	41 41 46.75	70 18 04.25	00 11 56	Hyannis	180 11 55	7265.0	7944.8	4.51
			69 15 11	Shootflying Hill	248 59 12	3571.0	3905.1	2.22
Barnstable (west spire)	41 41 52.74	70 22 41.93	295 24 03	Shootflying Hill	115 25 32	3419.0	3738.9	2.13
			84 08 02	Hamblin's Hill	264 37 16	1634.2	1787.1	1.02
Provincetown	42 03 06.41	70 10 59.11	17 54 16	Shootflying Hill	197 47 54	42820.9	46827.6	26.61
			67 31 32	Manomet Hill	247 15 24	36094.7	39472.1	22.43
Scargo Hill	41 44 20.33	70 10 28.37	121 35 15	Manomet Hill	301 18 49	39985.2	43726.6	24.84
			178 50 07	Provincetown	358 49 47	34746.0	37997.2	21.59
Griffin's Island	41 56 12.30	70 03 44.54	23 01 22	Scargo Hill	202 56 53	23857.8	26090.2	14.82
			141 59 11	Provincetown	321 54 20	16224.0	17742.1	10.08
Mill Hill	41 46 32.02	69 59 45.39	162 53 55	Griffin's Island	342 51 15	18731.8	20484.5	11.64
			74 45 45	Scargo Hill	254 38 37	15397.5	16838.2	9.57
Chatham	41 41 48.53	69 58 26.78	105 45 06	Scargo Hill	285 37 05	17322.7	18943.6	10.76
			168 16 29	Mill Hill	348 15 36	8931.9	9767.7	5.55
Yarmouth Port (spire)	41 42 22.77	70 14 15.70	302 02 42	German's Hill	122 04 02	3305.5	3614.8	2.05
			235 20 24	Scargo Hill	55 22 55	6386.3	6983.9	3.97
North Dennis	41 44 40.22	70 12 08.33	284 46 15	Scargo Hill	104 47 22	2389.6	2613.2	1.49
			1 21 45	German's Hill	181 21 44	5995.6	6556.6	3.73
North Dennis (white spire)	41 44 44.89	70 11 02.23	124 56 50	North Dennis	304 56 13	1533.6	1677.1	0.95
			255 41 02	Scargo Hill	75 41 31	1087.2	1188.9	0.68
North Dennis (gray spire)	41 44 42.89	70 11 00.44	122 33 46	North Dennis	302 33 08	1570.3	1717.2	0.98
			256 34 55	Scargo Hill	76 35 23	1014.8	1109.8	0.63

United States Coast Survey.—Geographical Positions. Section I.—Cape Cod and Cape Cod Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Sursuit Creek	41 45 32.29	70 08 07.07	55 49 44	Scargo Hill	235 48 11	3943.7	4312.7	2.45
			73 56 38	North Dennis	253 53 57	5799.3	6341.9	3.60
Monomoy	41 35 35.39	69 58 41.50	96 45 31	Point Gammon	276 34 30	23221.4	25394.2	14.43
			119 57 47	German's Hill	299 48 47	21693.5	23723.4	13.48
Monomoy Light	41 33 32.79	69 59 18.98	129 11 04	German's Hill	309 02 29	23130.3	25294.6	14.37
			184 31 48	Chatham	4 32 23	15341.4	16776.9	9.53
South Dennis	41 39 04.47	70 07 50.82	70 06 10	Point Gammon	250 01 13	11004.2	12033.9	6.84
			296 50 48	Monomoy	116 56 53	14254.1	15587.9	8.86
South Dennis (north spire)	41 40 32.12	70 09 02.91	93 44 53	Shootflying Hill	273 37 19	15882.7	17368.9	9.87
			53 22 19	Point Gammon	233 18 10	10794.9	11805.0	6.71
South Dennis (south spire)	41 40 19.50	70 09 12.07	95 07 23	Shootflying Hill	275 00 48	15932.4	17423.2	9.90
			55 07 23	Point Gammon	235 03 13	10602.6	11594.7	6.59
Herring River Spire	41 40 10.87	70 06 40.95	95 04 57	Shootflying Hill	274 55 48	19206.1	21003.2	11.93
			64 10 07	Point Gammon	244 04 24	13292.3	14536.1	8.26
Harwich Port	41 39 49.18	70.03 44.87	72 18 57	Point Gammon	252 11 15	16834.7	18409.9	10.46
			318 05 15	Monomoy	138 08 36	10514.3	11498.1	6.53
Morris' Island	41 39 27.39	69 57 12.25	94 16 09	Harwich Port	274 11 50	9105.3	9957.3	5.66
			16 06 30	Monomoy	196 05 31	7447.8	8144.7	4.63
West Chatham	41 40 07.32	70 01 20.41	282 05 16	Morris' Island	102 08 01	5870.1	6419.4	3.65
			336 18 45	Monomoy	156 20 30	9157.8	10014.7	5.69
Chatham Spire	41 41 00.70	69 57 18.11	133 04 11	Chatham	313 03 25	2165.6	2368.2	1.35
			357 18 48	Morris' Island	177 18 48	2881.6	3151.2	1.79

United States Coast Survey.—Geographical Positions. Section I.—Cape Cod and Cape Cod Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Chatham, (Congregational belfry.)	41 41 13.89	69 57 56.57	147 06 46	Chatham	327 06 26	1276.2	1395.6	0.79
			342 40 39	Morris' Island	162 41 08	3441.2	3763.2	2.14
Chatham South Light	41 40 14.84	69 56 36.93	138 41 08	Chatham	318 39 58	3815.6	4172.6	2.37
			87 45 11	West Chatham	267 42 02	6546.4	7159.0	4.07
Indian Brook	41 51 28.26	70 00 01.87	47 40 05	Scargo Hill	227 33 08	19581.5	21413.8	12.17
			357 36 51	Mill Hill	177 37 02	9146.5	10002.3	5.68
Eastham	41 49 23.98	69 59 53.34	358 01 05	Mill Hill	178 01 10	5308.0	5804.7	3.30
			57 29 15	Scargo Hill	237 22 12	17399.5	19027.6	10.81
Brewster	41 46 10.64	70 04 24.94	226 24 19	Eastham	46 27 20	8653.5	9463.2	5.38
			264 08 29	Mill Hill	84 11 35	6489.3	7096.5	4.03
Orleans	41 47 30.34	70 00 29.93	330 14 44	Mill Hill	150 15 14	2072.3	2266.2	1.29
			65 38 50	Brewster	245 36 13	5957.6	6515.1	3.70
Nausett Harbor	41 47 20.60	69 56 25.21	72 03 25	Mill Hill	252 01 12	4858.8	5313.5	3.02
			146 49 14	Indian Brook	326 46 49	9130.1	9984.4	5.67
Nausett Lights, (station south of.)	41 51 08.79	69 56 38.94	357 25 20	Nausett Harbor	177 25 30	7047.0	7706.4	4.38
			26 45 50	Mill Hill	206 43 45	9561.2	10455.8	5.94
Nausett Centre Light	41 51 36.54	69 56 43.82	7 28 38	Chatham	187 27 29	18294.8	20006.6	11.37
			54 49 01	Scargo Hill	234 39 51	23310.0	25491.1	14.48
Griffin's Island	41 56 12.30	70 03 44.54	23 01 22	Scargo Hill	202 56 53	23857.8	26090.2	14.82
			141 59 11	Provincetown	321 54 20	16224.0	17742.1	10.08
Billingsgate Point Light	41 51 36.70	70 03 55.20	328 27 18	Mill Hill	148 30 04	11026.2	12057.9	6.85
			34 01 29	Scargo Hill	213 57 07	16235.1	17754.2	10.09

United States Coast Survey.—Geographical Positions. Section I.—Cape Cod and Cape Cod Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Eastham, (Congregational spire.)	41 50 26.14	69 58 32.81	243 22 09	Nausett Lights, (station S. of)	63 23 25	2938.4	3213.4	1.83
			44 05 59	Eastham	224 05 06	2671.1	2921.0	1.66
Orleans, (Orthodox spire)	41 47 02.75	69 58 08.56	2 42 09	Pleasant Bay	182 42 03	4632.9	5066.4	2.88
			155 28 10	Griffin's Island	335 24 23	18640.3	20384.5	11.58
Nausett Beach	41 44 03.46	69 55 12.58	126 03 09	Mill Hill	306 06 07	7792.0	8521.1	4.84
			164 35 08	Nausett Harbor	344 34 20	6308.5	6898.8	3.92
Pleasant Bay	41 44 32.73	69 58 18.04	281 52 29	Nausett Beach	101 54 33	4378.5	4788.2	2.72
			2 16 53	Chatham	182 16 48	5070.1	5544.5	3.15
Blackfish Creek	41 54 26.78	70 00 43.27	35 52 22	Scargo Hill	215 45 51	23971.7	25230.5	14.34
			127 56 51	Griffin's Island	307 54 50	5295.9	5791.4	3.29
South Wellfleet, (Congregational spire.)	41 54 30.00	69 58 45.56	87 55 26	Blackfish Creek	267 54 08	2714.6	2968.6	1.69
			40 50 07	Scargo Hill	220 42 19	24834.7	27158.5	15.43
Lombard Head	41 55 49.60	69 58 29.46	50 21 55	Blackfish Creek	230 20 26	4004.0	4378.7	2.49
			95 32 32	Griffin's Island	275 29 01	7292.4	7974.8	4.53
Hamblin's Mound	41 56 12.14	70 02 25.95	277 15 10	Lombard Head	97 17 48	5491.8	6005.7	3.41
			323 56 27	Blackfish Creek	143 57 36	4020.0	4396.2	2.50
North Wellfleet, (Methodist belfry.)	41 56 17.59	70 01 27.45	343 25 18	Blackfish Creek	163 25 48	3566.3	3900.0	2.22
			29 28 18	Scargo Hill	209 22 18	25403.3	27780.3	15.79
North Wellfleet, (Congregational belfry.)	41 56 07.58	70 00 54.96	355 03 26	Blackfish Creek	175 03 34	3120.7	3412.7	1.94
			31 16 57	Scargo Hill	211 10 34	25515.3	27902.8	15.85
Cambria	41 59 12.84	70 00 23.52	337 15 41	Lombard Head	157 16 57	6789.0	7424.3	4.22
			26 50 07	Hamblin's Mound	206 48 45	6246.9	6831.4	3.88

United States Coast Survey.—Geographical Positions. Section I.—Cape Cod. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Pamet	42 00 12.85	70 04 31.19	287 58 18	Cambria	108 01 04	5992.2	6552.9	3.72
			351 45 46	Griffin's Island	171 46 17	7498.6	8200.3	4.66
Highland	42 01 39.29	70 02 25.99	10 19 21	Griffin's Island	190 09 29	10248.5	11207.5	6.37
			102 52 45	Provincetown	282 47 01	12102.9	13235.4	7.52
Highland Light	42 02 21.17	70 03 18.35	325 17 33	Cambria	145 19 50	7066.3	7727.5	4.39
			3 02 06	Griffin's Island	183 01 49	11395.1	12461.3	7.08
Truro, (Congregational spire).	41 59 52.02	70 02 56.95	106 31 27	Pamet	286 30 24	2262.2	2473.9	1.40
			9 11 20	Griffin's Island	189 10 49	6866.9	7509.4	4.27
Long Point Light	42 01 57.08	70 09 47.44	321 49 38	Griffin's Island	141 53 41	13523.9	14789.3	8.40
			293 48 51	Pamet	113 52 23	7954.6	8698.9	4.94
Stout	42 04 07.49	70 07 11.38	341 59 51	Griffin's Island	162 02 09	15412.9	16855.1	9.58
			333 00 43	Pamet	153 02 31	8122.8	8882.9	5.05
Race Point	42 04 48.38	70 12 05.27	280 33 00	Stout	100 36 17	6871.4	7514.4	4.27
			334 11 59	Provincetown	154 12 43	3494.1	3821.0	2.17
Race Point Light	42 03 42.30	70 14 15.59	235 45 23	Race Point	55 46 51	3623.7	3962.8	2.25
			313 39 16	Griffin's Island	133 46 19	20089.1	21968.8	12.48
Provincetown, (new Universalist spire.)	42 03 00.05	70 10 58.53	321 31 00	Griffin's Island	141 35 51	16061.3	17564.2	9.98
			176 20 22	Provincetown	356 20 22	197.3	215.8	0.12
Provincetown, (Orthodox spire.)	42 03 02.10	70 10 56.17	321 47 56	Griffin's Island	141 52 45	16075.5	17579.7	9.99
			153 31 18	Provincetown	333 31 16	151.9	166.1	0.09
Provincetown, (Methodist belfry.)	42 03 04.49	70 10 56.39	321 57 17	Griffin's Island	142 02 06	16138.6	17648.7	10.03
			133 42 33	Provincetown	313 42 32	86.3	94.4	0.05

United States Coast Survey.—Geographical Positions. Section I.—Cape Cod Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
13 Provincetown, (old Universalist belfry.)	42 02 49.01	70 11 05.58	195 28 50	Provincetown	15 28 55	557.3	609.5	0.35
			320 17 31	Griffin's Island	140 22 26	15899.5	17387.2	9.88
Provincetown	42 03 06.41	70 10 59.11	17 54 16	Shootflying Hill	197 47 54	42820.9	46827.6	26.61
			67 31 32	Manomet Hill	247 15 24	36094.7	39472.1	22.43
CAPE COD BAY.								
Peaked Cliff	41 48 29.27	70 32 03.77	162 15 33	Manomet Hill	342 13 31	13842.7	15137.9	8.60
			310 23 28	Shootflying Hill	130 31 11	21113.7	23089.3	13.12
Scorton Neck	41 44 16.99	70 24 19.82	126 02 17	Peaked Cliff	305 57 08	13242.5	14481.6	8.23
			144 36 28	Manomet Hill	324 29 17	25737.7	28145.9	15.99
Scorton Hill	41 43 15.11	70 23 20.06	315 15 42	Shootflying Hill	135 17 36	5641.4	6169.2	3.51
			111 45 20	Mount Schaum	291 40 34	10660.4	11657.8	6.62
Mount Schaum	41 45 22.96	70 30 28.67	159 06 05	Peaked Cliff	339 05 01	6152.8	6728.5	3.82
			283 23 52	Scorton Neck	103 27 57	8761.1	9580.8	5.44
Spring Hill Academy	41 44 56.72	70 27 15.24	286 48 37	Scorton Neck	106 50 34	4234.3	4630.5	2.63
			100 17 06	Mount Schaum	280 14 58	4541.2	4966.1	2.82
Sandwich, (Orthodox spire)	41 45 26.22	70 29 39.14	286 06 51	Scorton Neck	106 10 29	7679.9	8398.5	4.77
			84 58 47	Mount Schaum	264 58 14	1148.6	1256.1	0.71
Holmes' Hill	41 55 24.47	70 32 17.73	358 33 35	Peaked Cliff	178 33 44	12812.8	14011.7	7.96
			95 30 15	Manomet Hill	275 28 22	3914.6	4280.9	2.43
Monk's Hill	41 57 37.01	70 43 02.21	288 41 56	Manomet Hill	108 47 14	11560.9	12642.6	7.18
			334 59 54	Pine Hill	155 06 11	30895.8	33786.7	19 20

United States Coast Survey.—Geographical Positions. Section I.—Cape Cod Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Gurnet	42 00 09.34	70 35 44.82	354 04 09	Manomet Hill	174 04 35	8459.0	9250.5	5.26
			65 01 16	Monk's Hill	244 56 23	11110.5	12150.0	6.90
Plymouth	41 57 22.70	70 39 46.72	95 37 26	Monk's Hill	275 35 16	4523.1	4946.3	2.81
			296 53 43	Manomet Hill	116 56 50	7229.1	7905.5	4.49
Kingston	41 58 51.22	70 41 33.44	303 57 41	Monomet Hill	124 02 00	10737.4	11472.1	6.67
			318 00 37	Plymouth	138 01 48	3673.5	4017.2	2.28
Eel River Steeple	41 56 13.10	70 37 27.89	289 05 54	Manomet Hill	109 07 29	3438.0	3759.7	2.14
			108 37 03	Monk's Hill	288 33 20	8123.0	8883.0	5.05
Pier Head, Plymouth harbor	41 58 44.43	70 38 52.17	70 09 45	Monk's Hill	250 06 58	7777.5	8505.2	4.83
			238 42 23	Gurnet	58 44 29	5045.1	5517.1	3.14
North Plymouth Rope Works	41 58 45.42	70 40 58.95	250 16 15	Gurnet	70 19 47	7679.4	8397.9	4.77
			53 22 31	Monk's Hill	233 21 09	3536.3	3867.2	2.20
Kingston Spire	41 59 34.02	70 43 31.58	302 10 25	Manomet Hill	122 16 03	13737.0	15022.3	8.54
			224 09 47	Gurnet	84 15 00	10796.6	11806.8	6.71
Gurnet South Light	42 00 10.26	70 35 42.74	64 59 30	Monk's Hill	244 54 37	11165.8	12210.5	6.94
			331 41 00	Holmes' Hill	151 51 17	10000.5	10936.2	6.21
Standish	42 00 48.71	70 40 37.01	280 12 49	Gurnet	100 16 04	6831.8	7471.1	4.25
			29 29 11	Monk's Hill	209 27 33	6792.9	7428.5	4.22
Powder Point	42 02 47.09	70 38 49.55	158 47 22	White	338 45 52	8500.2	9295.6	5.28
			34 06 02	Standish	214 04 50	4409.6	4822.2	2.74
West Duxbury Spire	42 02 04.59	70 41 12.25	324 52 22	Manomet Hill	144 56 27	14628.9	15997.7	9.09
			295 14 12	Gurnet	115 17 51	8329.7	9109.1	5.18

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
East Duxbury Belfry	42 02 06.05	70 40 02.84	330 25 01	Manomet Hill	150 28 20	13811.8	15104.2	8.58
			301 12 56	Gurnet	121 15 49	6942.0	7591.6	4.31
MASSACHUSETTS BAY.								
Webster's Flagstaff	42 04 37.18	70 39 52.57	338 27 34	Manomet Hill	158 30 47	17926.1	19603.4	11.14
			325 23 20	Gurnet	145 26 08	10036.9	10976.1	6.24
Dan. Webster's West Chimney.	42 04 46.23	70 40 25.89	328 55 03	Powder Point	148 56 08	4291.3	4692.8	2.67
			168 31 34	White	348 31 08	4334.8	4740.4	2.69
Brant	42 05 15.28	70 38 07.48	340 49 06	Gurnet	160 50 42	9992.7	10927.7	6.21
			346 52 50	Manomet Hill	166 54 51	18329.5	20044.6	11.39
White	42 07 03.92	70 41 03.43	330 10 16	Gurnet	150 13 49	14739.1	16118.2	9.16
			338 50 12	Manomet Hill	158 53 11	22735.0	24862.3	14.13
Carolina Hill	42 06 56.48	70 43 31.67	319 26 31	Gurnet	139 31 44	16521.5	18067.4	10.27
			330 58 57	Manomet Hill	151 04 35	23974.7	26218.0	14.90
Sprague's Hill	42 00 15.81	70 57 39.02	237 31 31	Carolina Hill	57 40 59	23071.2	25230.0	14.34
			283 33 41	Monk's Hill	103 43 27	20768.4	22711.7	12.90
Lewis	42 08 07.44	70 42 52.55	347 01 28	Standish	167 02 59	13889.0	15188.6	8.63
			308 00 39	White	128 01 52	3181.1	3478.8	1.98
Third Cliff	42 10 47.81	70 42 40.81	3 07 08	Lewis	183 07 01	4954.9	5418.5	3.08
			342 03 19	White	162 04 25	7259.7	7939.0	4.51
Hatch	42 08 06.47	70 41 50.21	330 53 30	White	150 54 01	2208.5	2415.2	1.37
			166 52 04	Third Cliff	346 51 30	5111.1	5589.4	3.18

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Briggs	42 10 00.50	70 44 36.20	325 41 29	Lewis	145 42 39	4222.4	4617.5	2.62
			312 41 48	Hatch	132 43 39	5186.3	5671.6	3.22
North Marshfield. (Unitarian spire.)	42 08 28.15	70 44 08.34	281 53 32	Hatch	101 55 05	3241.5	3544.8	2.01
			167 21 13	Briggs	347 20 54	2920.2	3193.4	1.81
Nantasket	42 18 13.69	70 53 59.10	59 22 50	Blue Hill	239 14 24	20054.9	21931.4	12.46
			202 50 24	Thompson's Hill	22 57 30	37053.6	40520.7	23.02
Prospect Waltham	42 23 16.85	71 14 54.38	329 30 17	Blue Hill	149 35 56	22722.7	24848.9	14.12
			287 54 55	Nantasket	108 09 01	30213.1	33040.1	18.77
Nahant	42 25 02.81	70 53 57.13	37 09 08	Blue Hill	217 00 40	28652.0	31333.0	17.80
			0 12 17	Nantasket	180 12 15	12621.8	13802.8	7.84
Prospect Hingham	42 11 32.67	70 51 06.04	171 06 20	Nahant	351 04 25	25299.6	27666.9	15.72
			162 14 23	Nantasket	342 12 26	12993.1	14208.9	8.07
Powderhorn	42 24 02.72	71 01 30.96	18 10 39	Blue Hill	198 07 16	22103.6	24171.8	13.73
			259 49 35	Nahant	79 54 42	10540.3	11526.6	6.55
Dorchester Heights	42 20 01.45	71 02 14.85	23 28 37	Blue Hill	203 25 44	14781.3	16164.4	9.18
			230 43 03	Nahant	50 48 39	14699.6	16075.0	9.13
Deer Island	42 20 59.31	70 57 09.90	40 02 10	Blue Hill	219 55 52	20027.0	21900.9	12.44
			133 28 56	Powderhorn	313 26 00	8227.2	8997.0	5.11
Corey's Hill	42 20 31.39	71 07 41.19	232 22 35	Powderhorn	52 26 44	10688.9	11689.1	6.64
			277 01 13	Dorchester Heights	97 04 51	7526.5	8230.8	4.68
White's Hill	42 12 50.45	70 58 18.21	283 34 03	Prospect Hingham	103 38 53	10199.7	11154.1	6.34
			157 50 16	Dorchester Heights	337 47 37	14360.0	15703.7	8.92

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
East Weymouth Church.....	42 12 48.39	70 55 09.97	292 38 11	Prospect Hingham	112 40 55	6063.5	6630.9	3.77
			90 51 49	White's Hill..............	270 49 43	4317.7	4721.7	2.68
North Weymouth Church ...	42 13 44.45	70 56 21.85	201 29 03	Nantasket..................	21 30 38	8928.9	9764.4	5.55
			58 02 25	White's Hill..............	238 00 47	3144.8	3439.1	1.95
Weymouth, (flag on Great Hill.)	42 14 57.37	70 56 12 40	36 23 22	White's Hill..............	216 22 00	4863.6	5318.7	3.02
			206 44 47	Nantasket..................	26 46 17	6783.6	7418.4	4.22
Weymouth, (pole on King Oak Hill.)	42 13 36.91	70 56 04.24	198 33 08	Nantasket..................	18 34 32	9008.4	9851.3	5.60
			144 26 36	Dorchester Heights	324 22 25	14589.2	15954.3	9.07
Scituate Hill..............	42 14 12.64	70 49 30.08	140 22 19	Nantasket..................	320 19 18	9659.7	10563.6	6.00
			24 02 19	Prospect Hingham	204 01 15	5403.9	5909.5	3.36
Hayden's Hotel.............	42 15 08.37	70 45 58.96	46 38 46	Prospect Hingham	226 35 19	9688.7	10595.3	6.02
			117 28 55	Nantasket..................	297 25 12	12397.7	13557.8	7.70
Great Quincy...............	42 16 27.03	70 56 45.78	229 13 28	Nantasket..................	49 15 20	5040.7	5512.4	3.13
			319 20 53	Prospect Hingham	139 24 41	11964.5	13084.0	7.43
Crow Point.................	42 15 39.98	70 53 25.37	170 44 54	Nantasket..................	350 44 32	4805.2	5254.8	2.99
			337 16 02	Prospect Hingham	157 17 36	8272.0	9046.0	5.14
Quincy, (stone church)......	42 15 02.24	70 59 51.89	160 28 59	Dorchester Heights	340 27 23	9795.0	10711.5	6.09
			298 09 03	Prospect Hingham	118 14 56	13682.7	14963.0	8.50
Quincy, (black top church) ..	42 14 58.65	70 59 28.82	233 51 53	Great Quincy................	53 53 42	4625.6	5058.4	2.87
			337 43 59	White's Hill..............	157 44 46	4273.6	4673.5	2.66
Quincy, (church at Bent's Point.)	42 14 43.75	70 58 10.86	221 39 47	Nantasket..................	41 42 37	8673.8	9485.4	5.39
			2 45 45	White's Hill..............	182 45 40	3499.5	3827.0	2.20

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Hingham, (church on Great Plain.)	42 12 36.34	70 52 43.37	311 19 54	Prospect Hingham	131 21 00	2973.9	3252.2	1.85
			93 16 34	White's Hill	273 12 49	7691.9	8411.6	4.78
Sagamore Head, (signal)	42 16 22.45	70 51 28.92	91 08 33	Great Quincy	271 05 00	7262.5	7942.1	4.51
			134 56 38	Nantasket	314 54 57	4859.4	5314.1	3.02
Hingham, (new North church.)	42 14 32.32	70 53 08.34	169 24 35	Crow Point	349 24 24	2123.6	2322.3	1.32
			125 23 56	Great Quincy	305 21 30	6111.6	6683.5	3.80
Hingham, (old church)	42 14 26.70	70 52 53.85	162 17 25	Crow Point	342 17 04	2373.4	2595.5	1.47
			124 57 18	Great Quincy	304 54 42	6483.0	7089.6	4.03
Hingham, (cupola of Old Colony House.)	42 14 49.75	70 52 01.50	128 52 40	Crow Point	308 51 44	2469.1	2700.1	1.53
			194 37 29	Sagamore Head	14 37 51	2956.0	3232.6	1.84
Hingham, (Baker's Hill signal.)	42 14 33.92	70 54 07.37	60 59 34	White's Hill	240 56 45	6578.2	7193.7	4.09
			181 36 00	Nantasket	1 36 06	6783.4	7418.1	4.22
Hingham, (Turkey Hill signal.)	42 14 23.66	70 50 53.11	3 13 01	Prospect Hingham	183 12 52	5283.8	5778.2	3.28
			149 02 03	Nantasket	328 59 58	8278.4	9053.0	5.14
Eaton's Hill (Mount Wallaston) Flag.	42 15 42.07	70 59 32.36	238 28 16	Nantasket	58 32 01	8954.3	9792.2	5.56
			342 11 37	White's Hill	162 12 27	5560.8	6081.1	3.46
Cat Hill Signal	42 13 17.17	70 44 59.14	69 04 13	Prospect Hingham	249 00 08	9011.9	9855.1	5.60
			105 25 37	Scituate Hill	285 22 35	6443.7	7046.6	4.00
Cohasset Church	42 14 33.63	70 47 52.87	300 37 07	Cat Hill Signal	120 39 04	4629.1	5062.2	2.88
			247 40 11	Hayden's Hotel	67 41 28	2822.2	3086.3	1.75
Minot's Ledge Light-house	42 16 09.16	70 45 13.56	356 26 17	Cat Hill Signal	176 26 27	5316.8	5814.3	3.30
			58 34 46	Scituate Hill	238 31 54	6891.9	7536.8	4.28

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Scituate Light............	42 12 15.26	70 42 37.43	120 27 30	Cat Hill Signal............	300 25 54	3770.1	4122.9	2.34
			81 11 30	Scituate Unitarian Church...	261 09 53	3333.8	3645.8	2.07
Scituate, (Unitarian spire)..	42 11 58.68	70 45 01.03	123 50 24	Scituate Hill...............	303 47 23	7426.0	8120.9	4.62
			84 33 33	Prospect Hingham..........	264 29 27	8412.0	9199.1	5.23
Parker's Hill Signal........	42 13 43.60	70 46 28.29	194 24 55	Hayden's Hotel.............	14 25 15	2700.9	2953.6	1.68
			57 38 51	Prospect Hingham..........	237 35 44	7542.8	8248.8	4.69
Forbes......................	42 15 25.85	71 01 17.89	171 16 47	Dorchester Heights.........	357 16 08	8602.1	9407.0	5.35
			242 42 18	Nantasket..................	62 47 13	11308.2	12366.3	7.03
Paine's Hill Observatory, Braintree.	42 13 59.55	70 59 21.88	135 03 03	Forbes.....................	315 01 45	3763.0	4115.1	2.34
			218 09 45	Great Quincy...............	38 11 30	5788.4	6330.0	3.60
Thayer's Hill, (chimney of yellow house,) Braintree.	42 13 49.47	70 57 49.44	196 42 17	Great Quincy...............	16 43 00	5075.1	5550.0	3.15
			266 22 51	Scituate Hill..............	86 28 27	11471.3	12544.7	7.13
Grape Island, (flag)........	42 16 05.27	70 55 06.10	288 40 13	Crow Point.................	108 41 21	2436.6	2664.6	1.51
			201 10 19	Nantasket..................	21 11 04	4248.6	4646.1	2.64
Bunkin Island, (flag).......	42 16 49.86	70 53 41.74	80 31 38	Great Quincy...............	260 29 34	4274.9	4674.9	2.66
			171 15 38	Nantasket..................	351 15 26	2616.8	2861.7	1.63
Pig Rock Beacon...........	42 16 42.05	70 56 01.55	168 51 00	Deer Island................	348 50 15	8089.6	8846.6	5.03
			224 45 24	Nantasket..................	44 46 46	3982.8	4355.5	2.48
Atlantic House, (chimney)..	42 16 01.01	70 50 31.90	95 23 10	Great Quincy...............	275 18 59	8604.1	9409.2	5.35
			337 01 45	Scituate Hill..............	157 02 27	3631.2	3971.0	2.26
Cohasset, (Black Rock signal)	42 16 06.54	70 49 07.28	93 29 00	Great Quincy...............	273 23 52	10524.7	11509.5	6.54
			120 25 51	Nantasket..................	300 22 35	7750.9	8476.2	4.79

United States Coast Survey.—Geographical Positions. ***Section I.—Massachusetts Bay.*** *Sketch A.*

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Hangman's Ledge, (sunken beacon.)	42 17 42.76	70 57 18.11	181 46 32	Deer Island	1 46 37	6066.9	6634.6	3.78
			122 13 38	Dorchester Heights	302 10 18	8029.9	8781.3	4.99
Squantum	42 18 11.91	71 00 20.51	180 37 02	Governor's Island	0 37 04	5381.9	5885.5	3.34
			269 36 02	Nantasket	89 40 18	8735.1	9552.5	5.43
Roxbury, (Sargent's observatory.)	42 18 40.75	71 05 20.37	136 39 01	Corey's Hill	316 37 27	4695.4	5134.8	2.92
			239 36 12	Dorchester Heights	59 38 16	4923.2	5383.9	3.06
Milton Mills, (tall-spired church.)	42 16 24.51	71 03 46.93	197 28 33	Dorchester Heights	17 29 35	7017.3	7673.9	4.36
			153 01 01	Sargent's Observatory	332 59 58	4716.8	5158.1	2.93
Milton, (old church)	42 15 10.33	71 04 29.34	156 05 42	Corey's Hill	336 03 33	10836.3	11850.3	6.73
			198 55 03	Dorchester Heights	18 56 33	9495.1	10383.6	5.90
Wellington Hill, (flag)	42 16 57.22	71 05 23.04	154 25 47	Corey's Hill	334 24 14	7325.6	8011.1	4.55
			217 09 12	Dorchester Heights	37 11 18	7132.3	7799.7	4.43
Neponset Village, (church)	42 17 09.61	71 02 31.83	184 11 18	Dorchester Heights	4 11 29	5315.4	5812.8	3.30
			237 24 36	Squantum	57 26 04	3569.2	3903.2	2.22
Dorchester, (Dr. Codman's church.)	42 17 24.85	71 03 56.95	205 48 42	Dorchester Heights	25 49 51	5367.0	5869.2	3.33
			140 47 33	Sargent's Observatory	320 46 37	3022.0	3304.8	1.88
Dorchester, (flag on Commercial Point wharf.)	42 17 58.29	71 02 17.18	180 48 10	Dorchester Heights	0 48 12	3800.1	4155.7	2.36
			261 03 00	Squantum	81 04 19	2705.2	2958.3	1.68
Dorchester, (summer-house on hill.)	42 18 07.14	71 04 14.61	217 51 19	Dorchester Heights	37 52 39	4467.1	4885.1	2.78
			268 24 20	Squantum	88 26 58	5363.7	5865.6	3.33
Dorchester, (church with clock.)	42 18 27.61	71 03 24.78	208 56 02	Dorchester Heights	28 56 49	3308.0	3617.5	2.06
			98 43 01	Sargent's Observatory	278 41 43	2677.8	2928.4	1.66

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Roxbury, (tall-spired church, Jamaica Plains.)	42 18 34.44	71 06 38.36	158 15 58	Corey's Hill	338 15 16	3884.3	4247.8	2.41
			263 46 26	Sargent's Observatory	83 47 18	1796.1	1964.2	1.12
Roxbury, (chimney of laboratory.)	42 19 22.52	71 05 31.94	212 30 33	Powderhorn	32 33 15	10253.8	11213.3	6.37
			255 04 39	Dorchester Heights	75 06 52	4669.0	5105.9	2.90
Roxbury, (Doctor Putnam's church.)	42 19 45.82	71 05 03.93	201 33 47	Powderhorn	21 36 11	9304.0	10174.6	5.78
			111 20 51	Corey's Hill	291 19 05	3864.4	4226.0	2.40
Roxbury, (new Unitarian church.)	42 19 40.12	71 04 30.68	109 57 24	Corey's Hill	289 55 15	4638.9	5073.0	2.88
			258 02 14	Dorchester Heights	78 03 46	3178.2	3475.6	1.98
Brookline, (Doctor Peirce's church.)	42 19 36.18	71 07 31.47	172 33 40	Corey's Hill	352 33 34	1717.8	1878.5	1.07
			225 03 14	Powderhorn	45 07 17	11647.6	12737.5	7.24
Governor's Island	42 21 06.33	71 00 17.96	53 12 14	Dorchester Heights	233 10 55	3341.5	3654.2	2.08
			272 52 01	Deer Island	92 54 08	4309.4	4712.6	2.68
Moon Head	42 18 20.20	70 59 01.99	271 37 42	Nantasket	91 41 07	6939.5	7588.8	4.31
			161 15 34	Governor's Island	341 14 41	5412.4	5918.9	3.36
Pettick's Island, (flag on north end.)	42 18 04.29	70 55 26.49	156 19 51	Deer Island	336 18 42	5895.8	6447.5	3.66
			261 44 11	Nantasket	81 45 09	2022.1	2211.3	1.26
George's Island	42 19 09.17	70 55 21.22	143 47 57	Deer Island	323 46 43	4211.3	4604.5	2.62
			118 02 51	Governor's Island	297 59 33	7694.6	8414.6	4.78
Great Brewster	42 19 59.98	70 53 24.06	109 31 14	Deer Island	289 28 41	5483.4	5996.5	3.41
			90 15 46	Dorchester Heights	270 09 50	12150.5	13287.4	7.55
Point Allerton, (flag)	42 18 35.13	70 52 38.26	158 10 16	Great Brewster	338 09 45	2819.9	3083.8	1.75
			70 21 28	Nantasket	250 20 34	1965.8	2149.7	1.22

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Watertown, (flag on Gallop Island.)	42 19 35.32	70 56 00.37	148 27 01	Deer Island	328 26 14	3040.9	3325.4	1.89
			115 29 27	Governor's Island	295 26 34	6530.7	7141.8	4.06
Nix's Mate	42 19 51.58	70 56 19.84	112 57 29	Governor's Island	292 54 48	5918.2	6472.0	3.68
			151 15 58	Deer Island	331 15 24	2383.0	2606.0	1.48
Rainsford Island, (flag-staff)	42 18 44.84	70 56 46.32	172 35 14	Deer Island	352 34 59	4183.5	4575.0	2.60
			284 04 01	Nantasket	104 05 53	3948.0	4317.4	2.45
Long Island, (flag on south end of.)	42 18 37.53	70 58 16.08	277 05 48	Nantasket	97 08 41	5930.8	6485.8	3.69
			148 43 11	Governor's Island	328 41 48	5372.3	5875.0	3.34
Long Island Light	42 19 46.15	70 57 03.03	44 55 17	Blue Hill	224 48 55	18467.2	20195.2	11.48
			93 48 39	Dorchester Heights	273 45 10	7153.8	7823.2	4.44
Deer Island Beacon	42 20 21.47	70 56 57.32	106 47 36	Governor's Island	286 45 20	4796.3	5245.1	2.98
			166 08 47	Deer Island	346 08 37	1202.3	1314.8	0.75
Boston Light	42 19 38.77	70 53 05.06	173 12 38	Nahant	353 12 02	10067.9	11009.9	6.26
			55 14 32	Blue Hill	235 05 30	22515.7	24622.5	13.99
Barrel Beacon, (near Boston light.)	42 19 20.29	70 54 48.08	133 16 16	Deer Island	313 14 41	4457.7	4874.8	2.77
			113 27 23	Governor's Island	293 23 41	8229.4	8999.4	5.11
Outer Brewster	42 20 27.50	70 52 19.98	28 48 29	Nantasket	208 47 22	4710.8	5151.6	2.93
			59 55 44	Great Brewster	239 55 01	1695.0	1853.6	1.05
Strawberry Hill, (barn)	42 17 20.53	70 52 28.35	22 51 19	Crow Point	202 50 41	3365.4	3680.3	2.09
			74 23 12	Great Quincy	254 20 19	6124.0	6697.0	3.81
Lovell's Island, (pole)	42 19 46.62	70 55 29.27	261 48 26	Great Brewster	81 49 50	2895.5	3166.4	1.80
			324 13 49	Nantasket	144 14 50	3532.7	3863.3	2.20

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Spectacle Island, (pole)	42 19 36.94	70 58 55.59	145 38 54	Governor's Island	325 37 59	3340.8	3653.4	2.05
			290 41 31	Nantasket	110 44 50	7258.3	7937.5	4.51
Thompson's Island, (flag)	42 19 12.62	70 59 55.05	115 13 04	Dorchester Heights	295 11 30	3537.5	3868.5	2.20
			171 29 56	Governor's Island	351 29 40	3547.4	3879.3	2.21
Thompson's Island, (pole near Farm School.)	42 19 05.56	71 00 04.94	120 06 28	Dorchester Heights	300 05 01	3437.7	3759.4	2.14
			12 08 41	Squantum	192 08 31	1693.6	1852.1	1.05
Green Island, (flag)	42 21 09.18	70 53 11.95	11 16 48	Nantasket	191 16 16	5520.6	6037.2	3.43
			86 49 04	Deer Island	266 46 24	5454.0	5964.3	3.39
Graves Signal	42 21 51.68	70 51 51.49	154 01 50	Nahant	334 00 24	6559.6	7173.4	4.08
			23 29 20	Nantasket	203 27 55	7332.1	8018.2	4.56
Bluff Head, (flag)	42 22 01.86	70 57 43.46	59 08 22	Dorchester Heights	239 05 21	7237.0	7914.2	4.50
			323 51 48	Nantasket	143 54 21	8713.6	9528.9	5.41
Grover's Cliff	42 23 20.83	70 57 47.57	348 59 55	Deer Island	168 50 20	4450.6	4867.1	2.77
			239 08 01	Nahant	59 10 37	6137.0	6711.2	3.81
Castle Island	42 20 17.28	71 00 24.59	253 45 31	Deer Island	73 47 42	4640.7	5074.9	2.88
			79 03 12	Dorchester Heights	259 01 58	2571.0	2811.6	1.60
Point Shirley, (chimney of foundry.)	42 21 29.84	70 57 59.13	65 02 21	Dorchester Heights	244 59 30	6456.5	7060.6	4.01
			77 10 07	Governor's Island	257 08 33	3258.8	3563.7	2.02
Apple Island, (flag)	42 21 29.60	70 59 11.37	288 34 19	Deer Island	108 35 41	2932.6	3207.0	1.82
			57 05 19	Dorchester Heights	237 03 15	5003.2	5471.4	3.11
South Boston Point	42 20 11.03	71 01 12.40	216 07 38	Governor's Island	36 08 16	2112.6	2310.3	3.31
			176 36 06	Powderhorn	356 35 53	7160.8	7830.8	4.45

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Boston, State House	42 21 27.62	71 03 30.00	327 05 44	Dorchester Heights	147 06 35	3166.3	3462.6	1.97
			73 13 59	Corey's Hill	253 11 02	6004.5	6566.3	3.73
Boston, Faneuil Hall	42 21 34.40	71 03 02.68	339 06 28	Dorchester Heights	159 07 00	3069.8	3357.0	1.91
			204 36 51	Powderhorn	24 37 53	5033.8	5504.8	3.13
Bunker Hill Monument	42 22 33.07	71 03 19.52	342 26 33	Dorchester Heights	162 27 16	4906.4	5365.5	3.05
			221 54 12	Powderhorn	41 55 26	3716.8	4064.6	2.31
Boston, Cunard Wharf, (flag-staff.)	42 21 48.10	71 02 05.86	3 35 09	Dorchester Heights	183 35 03	3297.0	3605.5	2.05
			297 33 26	Governor's Island	117 34 39	2784.7	3045.3	1.73
Boston, Long Wharf Station	42 21 35.67	71 02 32.71	197 17 13	Powderhorn	17 17 55	4751.3	5195.9	2.95
			286 21 03	Governor's Island	106 22 34	3213.3	3514.0	2.00
Boston, Battery Wharf	42 21 59.33	71 02 38.16	296 59 51	Governor's Island	117 01 26	3600.5	3937.4	2.24
			201 59 12	Powderhorn	21 59 58	4105.3	4489.4	2.55
Boston, Cupola Lewis' Wharf	42 21 45.46	71 02 38.96	290 30 06	Governor's Island	110 31 41	3444.8	3767.1	2.14
			200 09 48	Powderhorn	20 10 33	4511.4	4933.5	2.80
Boston, Hollis Street Church	42 20 57.44	71 03 32.08	314 19 35	Dorchester Heights	134 20 27	2472.0	2703.3	1.54
			205 50 53	Powderhorn	25 52 15	6352.4	6946.8	3.95
Boston, Hanover St. Church, (with cock on spire.)	42 21 47.93	71 02 56.38	343 51 28	Dorchester Heights	163 51 56	3420.2	3740.2	2.13
			205 09 18	Powderhorn	25 10 16	4594.8	5024.7	2.86
Boston, Navy-yard	42 22 22.00	71 02 45.27	208 40 09	Powderhorn	28 40 59	3542.0	3873.4	2.20
			304 41 39	Governor's Island	124 43 18	4099.9	4483.5	2.55
South Boston, (Blind Asylum cupola.)	42 20 05.06	71 02 11.80	187 15 30	Powderhorn	7 15 58	7391.5	8083.1	4.59
			234 01 35	Governor's Island	54 02 51	3218.8	3520.0	2.00

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
East Boston Point, (flag)	42 21 56.27	71 01 23.71	286 48 50	Deer Island	106 51 42	6067.9	6635.7	3.77
			315 40 49	Governor's Island	135 41 34	2153.3	2354.8	1.34
East Boston Station	42 22 51.15	71 01 50.68	298 12 55	Deer Island	118 16 03	7292.3	7974.6	4.53
			326 43 40	Governor's Island	146 44 43	3867.5	4229.4	2.40
Bird Island Signal	42 21 20.79	71 00 54.91	155 24 10	East Boston	335 23 33	3065.7	3352.6	1.91
			93 24 07	State House	273 22 22	3555.2	3887.9	2.21
Belle Isle Signal	42 22 55.34	70 59 35.29	87 36 43	East Boston	267 35 12	3100.3	3390.4	1.93
			128 10 05	Powderhorn	308 08 47	3364.2	3679.0	2.09
Winisimet Village, (church with clock.)	42 23 25.36	71 01 57.13	3 41 23	Dorchester Heights	183 41 11	6304.2	6894.1	3.92
			55 44 39	Corey's Hill	235 40 47	9527.4	10418.9	5.92
Waite No. 1	42 25 58.87	71 03 36.93	277 22 49	Nahant	97 29 20	13365.0	14615.6	8.30
			28 57 44	Corey's Hill	208 54 59	11545.4	12625.7	7.17
Ten Hill Farm	42 23 48.92	71 04 54.22	264 44 46	Powderhorn	84 47 03	4667.6	5104.3	2.90
			336 08 50	State House	156 09 47	4766.1	5212.1	2.96
Malden Bridge, (chimney of yellow house at toll-gate.)	42 23 32.59	71 03 48.56	253 32 04	Powderhorn	73 33 37	3280.9	3587.9	2.04
			183 22 12	Waite No. 1	3 22 20	4520.6	4943.6	2.81
Malden, (tall-spired church with clock.)	42 25 36.88	71 03 40.53	314 25 46	Powderhorn	134 27 13	4149.0	4537.2	2.58
			30 18 31	Corey's Hill	210 15 51	10914.9	11936.2	6.78
Somerville, (church on hill.)	42 23 10.19	71 05 31.36	31 14 27	Corey's Hill	211 12 59	5729.7	6265.8	3.56
			253 33 18	Powderhorn	73 36 00	5731.8	6268.1	3.56
Somerville, (church near Malden bridge.)	42 23 05.45	71 04 15.61	44 43 14	Corey's Hill	224 40 56	6687.3	7313.0	4.16
			244 50 52	Powderhorn	64 52 43	4159.3	4548.5	2.58

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Somerville, (stone powder-house.)	42 23 58.44	71 06 39.16	268 53 50	Powderhorn	88 57 17	7048.8	7708.4	4.38
			12 31 54	Corey's Hill	192 31 12	6543.8	7156.1	4.07
Medford, (Unitarian church.)	42 25 12.00	71 06 35.21	287 03 11	Powderhorn	107 06 36	7277.2	7958.1	4.52
			9 53 41	Corey's Hill	189 52 57	8788.3	9610.3	5.46
Cambridgeport, (Universalist church.)	42 21 45.54	71 05 39.86	50 31 30	Corey's Hill	230 30 08	3597.9	3934.6	2.24
			233 21 01	Powderhorn	53 23 49	7093.9	7757.7	4.41
Cambridge, (Unitarian ch.)	42 22 26.72	71 06 49.76	247 51 50	Powderhorn	67 55 24	7870.0	8606.4	4.87
			18 18 18	Corey's Hill	198 17 44	3748.0	4098.7	2.33
Cambridge, (Baptist church.)	42 22 32.44	71 06 46.70	18 28 08	Corey's Hill	198 27 31	3937.3	4305.7	2.45
			248 52 42	Powderhorn	68 56 15	7740.0	8464.2	4.81
Cambridge Observ'y, (dome.)	42 22 51.51	71.07 22.88	5 32 17	Corey's Hill	185 32 05	4343.5	4749.9	2.70
			254 42 02	Powderhorn	74 45 59	8343.0	9123.7	5.18
Cambridge, (meridian mark.)	42 25 45.47	71 07 22.53	291 29 30	Powderhorn	111 33 27	8640.0	9448.4	5.37
			2 31 27	Corey's Hill	182 31 14	9699.5	10607.1	6.03
West Cambridge, (church with clock.)	42 24 53.66	71 08 54.84	348 13 58	Corey's Hill	168 14 48	8265.2	9038.6	5.14
			278 45 44	Powderhorn	98 50 43	10270.1	11231.1	6.38
Brighton, (West church with clock.)	42 20 54.26	71 08 59.29	240 24 32	Powderhorn	60 29 35	11789.5	12892.6	7.33
			291 32 23	Corey's Hill	111 33 16	1921.7	2101.5	1.19
Brighton, (East church)	42 20 55.84	71 08 52.03	240 12 49	Powderhorn	60 17 46	11620.9	12708.3	7.22
			294 57 09	Corey's Hill	114 57 57	1788.0	1955.3	1.11
Watertown, United States Arsenal, (flag.)	42 21 40.74	71 09 24.98	247 57 24	Powderhorn	68 02 44	11694.0	12788.2	7.27
			312 00 25	Corey's Hill	132 01 35	3196.7	3595.8	1.99

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Watertown, (skylight of J. P Cushing's house.)	42 22 46.59	71 09 49.25	258 18 30	Powderhorn	78 24 05	11635.6	12724.4	7.23
			324 54 14	Corey's Hill	144 55 40	5097.7	5574.7	3.17
Waite No. 2	42 26 18.48	71 00 52.08	283 47 24	Nahant	103 52 04	9767.4	10681.3	6.07
			11 58 58	Powderhorn	191 58 32	4281.9	4682.6	2.66
Ballard's Hill	42 27 15.60	70 59 11.51	28 11 15	Powderhorn	208 09 41	6750.8	7382.5	4.19
			299 39 53	Nahant	119 43 25	8270.5	9044.4	5.14
Chelsea, (village church)	42 24 31.02	71 00 05.22	19 38 16	Dorchester Heights	199 36 49	8830.1	9656.3	5.49
			65 59 54	Powderhorn	245 58 56	2146.1	2346.9	1.33
Chelsea, (Cushman's house cupola.)	42 24 57.38	71 00 23.53	201 06 01	Ballard's Hill	21 06 49	4570.8	4998.5	2.84
			309 51 34	Grover's Cliff	129 53 19	4646.7	5081.5	2.89
Chelsea, (Neptune House flag-staff.)	42 25 41.53	70 58 25.69	348 38 38	Grover's Cliff	168 39 04	4427.4	4841.7	2.75
			54 16 31	Powderhorn	234 14 26	5218.5	5706.8	3.24
Chelsea, (Crusoe House flag-staff.)	42 26 08.70	70 57 46.52	0 16 01	Grover's Cliff	180 16 00	5179.3	5663.9	3.22
			52 52 34	Powderhorn	232 50 03	6436.9	7039.2	4.00
Little Nahant	42 26 11.31	70 55 30.98	314 33 56	Nahant	134 35 00	3011.8	3293.5	1.87
			111 30 16	Ballard's Hill	291 27 48	5415.0	5921.7	3.36
Nahant Hotel	42 25 07.24	70 53 58.75	50 18 29	Dorchester Heights	230 12 55	14758.2	16139.1	9.17
			79 08 37	Powderhorn	259 03 32	10528.8	11514.0	6.54
Egg Rock Signal	42 25 58.45	70 53 32.26	18 20 11	Nahant	198 19 54	1808.4	1977.6	1.12
			98 20 06	Little Nahant	278 18 46	2742.8	2999.5	1.71
Lynn, (East church with green tower.)	42 28 05.18	70 55 55.33	45 44 58	Powderhorn	225 41 12	10714.3	11716.8	6.66
			334 20 49	Nahant	154 22 10	6241.3	6825.3	3.88

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Lynn, (West church turret)..	42 27 43.77	70 57 15.92	71 47 39	Ballard's Hill................	251 46 20	2779.9	3040.0	1.73
			5 05 54	Grover's Cliff................	185 05 33	8144.5	8906.6	5.06
Lynn, (high rock, pole near swing.)	42 28 03.00	70 56 31.04	68 16 01	Ballard's Hill................	248 14 13	3947.0	4316.3	2.45
			11 22 12	Grover's Cliff................	191 21 20	8879.9	9710.8	5.52
Orne's Hill..............	42 30 08.31	70 57 33.37	237 50 40	Thompson's Hill	58 00 12	22757.0	24886.4	14.14
			142 53 13	Holt's Hill	322 47 28	19271.9	21075.2	11.97
Coddon's Hill..............	42 30 57.25	70 50 56.39	80 34 57	Orne's Hill................	260 30 29	9186.6	10046.2	5.71
			223 59 43	Thompson's Hill	44 04 47	14712.0	16088.6	9.14
Folly Hill	42 33 57.20	70 54 27.10	31 03 43	Orne's Hill................	211 01 37	8241.7	9012.9	5.12
			319 05 30	Coddon's Hill................	139 07 53	7344.2	8031.4	4.56
Danvers New Mills, (tall spire)	42 33 18.80	70 55 09.45	29 12 46	Orne's Hill................	209 11 08	6731.7	7361.6	4.18
			307 04 40	Coddon's Hill................	127 07 32	7239.6	7917.3	4.50
South Danvers, (spire)......	42 31 33.46	70 55 19.47	49 20 42	Orne's Hill................	229 19 11	4029.9	4407.0	2.50
			280 30 57	Coddon's Hill................	100 33 56	6106.8	6678.2	3.79
Upper Beverly, (spire)......	42 36 28.79	70 50 33.92	39 13 25	Orne's Hill................	219 08 40	15143.3	16560.3	9.41
			48 41 02	Folly Hill	228 38 23	7080.5	7743.0	4.40
Beverly, (powder-house)	42 33 10.69	70 52 12.03	52 32 01	Orne's Hill................	232 28 22	9242.6	10107.4	5.74
			337 14 56	Coddon's Hill................	157 15 47	4464.2	4881.9	2.77
Beverly, (spire with turrets).	42 32 49.17	70 52 22.40	55 04 12	Orne's Hill................	235 00 42	8659.2	9469.4	5.38
			126 26 40	Folly Hill	306 25 15	3535.4	3866.2	2.20
Manchester Church, (turret)	42 34 28.32	70 45 59.83	63 11 09	Orne's Hill................	243 03 16	17741.0	19401.0	11.02
			46 07 21	Coddon's Hill................	226 03 59	9390.7	10269.4	5.83

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Fort Lee	42 31 52.79	70 52 07.83	66 35 00	Orne's Hill	246 31 19	8099.0	8856.8	5.03
			140 23 57	Folly Hill	320 22 22	4982.9	5449.2	3.10
Salem, (tall spire)	42 31 10.10	70 53 38.25	70 28 29	Orne's Hill	250 25 50	5695.2	6228.1	3.54
			276 06 38	Coddon's Hill	96 08 27	3715.4	4063.1	2.31
Ware's Hill, (flag-staff)	42 30 38.69	70 54 11.68	78 31 32	Orne's Hill	258 29 12	4698.2	5137.9	2.92
			262 39 35	Coddon's Hill	82 41 47	4494.3	4914.8	2.79
Marblehead, (black-top ch.)	42 30 23.73	70 50 32.98	87 12 23	Orne's Hill	267 07 38	9608.6	10507.7	5.97
			152 40 52	Coddon's Hill	332 40 36	1163.9	1272.8	0.72
Marblehead Neck, (flag)	42 29 45.03	70 50 07.90	94 05 16	Orne's Hill	274 00 15	10195.6	11149.6	6.34
			153 35 40	Coddon's Hill	333 35 07	2488.1	2720.9	1.55
Marblehead (Mr. Brookhouse's cupola.)	42 29 06.63	70 52 52.65	106 34 10	Orne's Hill	286 31 00	6686.3	7311.9	4.16
			217 51 37	Coddon's Hill	37 52 56	4323.5	4728.1	2.69
Ocean House cupola	42 28 51.80	70 52 12.50	107 53 43	Orne's Hill	287 50 06	7697.5	8418.0	4.78
			204 10 26	Coddon's Hill	24 11 18	4242.7	4639.7	2.64
Spire made into summer-house	42 28 53.15	70 52 42.35	109 15 31	Orne's Hill	289 12 14	7038.2	7696.8	4.37
			212 16 51	Coddon's Hill	32 18 03	4529.9	4953.8	2.82
Lynn, (summer-house on high rock.)	42 28 03.12	70 56 27.76	158 48 40	Orne's Hill	338 47 56	4143.8	4531.5	2.58
			234 35 31	Coddon's Hill	54 39 15	9279.8	10148.1	5.77
Legg's Hill	42 29 21.38	70 53 09.71	103 33 30	Orne's Hill	283 30 32	6191.8	6771.2	3.85
			225 48 17	Coddon's Hill	45 49 47	4244.2	4641.3	2.63
Danvers Plain, (tall spire)	42 34 01.41	70 55 57.20	309 35 33	Coddon's Hill	129 38 57	8909.8	9743.5	5.54
			273 36 13	Folly Hill	93 37 14	2058.9	2251.6	1.28

United States Coast Survey.—Geographical Positions. Section I.—Cape Ann. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Beverly Point, (flag on tree)..	42 32 57.15	70 53 54.37	43 50 35	Orne's Hill..................	223 48 07	7218.2	7893.6	4.48
			158 03 45	Folly Hill..................	338 03 23	1997.3	2184.2	1.24
Little Haste Beacon.........	42 32 05.80	70 50 14.81	24 10 05	Coddon's Hill..............	204 09 37	2318.0	2534.9	1.44
			120 52 20	Folly Hill..................	300 49 25	6703.5	7330.8	4.17
Coney Island, (flag).........	42 31 40.97	70 49 53.64	46 43 21	Coddon's Hill..............	226 42 38	1967.2	2151.3	1.22
			123 59 50	Folly Hill..................	303 56 45	7522.4	8226.3	4.67
Bowditch's Ledge, (beacon)..	42 32 23.46	70 48 22.03	52 57 23	Coddon's Hill..............	232 55 39	4414.0	4827.0	2.74
			109 11 12	Folly Hill..................	289 07 04	8815.5	9640.4	5.48
North Gooseberry, (flag)....	42 31 34.06	70 47 18.00	77 11 05	Coddon's Hill..............	257 08 37	5112.0	5590.3	3.18
			114 19 24	Folly Hill..................	294 14 32	10739.5	11744.4	6.67
Cat Island, (pole on east rock)	42 30 30.68	70 48 23.84	103 15 37	Coddon's Hill..............	283 13 54	3577.2	3911.9	2.22
			127 35 09	Folly Hill..................	307 31 03	10454.5	11432.7	6.50
Cat Island, (flag-staff)........	42 30 41.59	70 48 34.22	98 29 04	Coddon's Hill..............	278 27 28	3280.8	3587.8	2.04
			126 53 21	Folly Hill..................	306 49 22	10062.3	11003.8	6.25
CAPE ANN.								
Thompson's Hill...........	42 36 40.03	70 43 27.99	... .	....	... .	....	....	....
Brown's Hill...............	42 36 43.80	70 50 28.87	270 39 12	Thompson's Hill............	90 43 57	9592.3	10489.9	5.96
			98 31 06	Holt's Hill..................	278 20 34	21535.7	23550.8	13.38
Baker's Island Light........	42 32 09.61	70 46 50.08	208 53 33	Thompson's Hill............	28 55 50	9531.7	10423.6	5.92
			75 45 49	Orne's Hill..................	255 38 34	15151.3	16569.0	9.41
Bolles....................	42 35 04.05	70 47 14.29	124 46 22	Brown's Hill................	304 44 10	5398.4	5903.5	3.35
			240 07 09	Thompson's Hill............	60 09 42	5948.1	6504.7	3.70

United States Coast Survey.—Geographical Positions. Section I.—Cape Ann. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Beverly Rock	42 33 56.88	70 49 53.85	171 11 25	Brown's Hill	351 11 02	5211.4	5699.0	3.24
			240 19 04	Bolles	60 20 52	4187.2	4579.0	2.60
Kettle Island	42 33 59.38	70 43 00.78	57 05 51	Baker's Island Light	237 03 17	6231.5	6814.6	3.87
			109 03 58	Bolles	289 04 05	6115.6	6687.9	3.80
Halfway Rock Beacon	42 30 07.45	70 46 10.24	103 15 44	Coddon's Hill	283 12 31	6710.4	7338.3	4.17
			211 07 19	Kettle Island	31 09 27	8360.4	9142.7	5.19
Prospect Rowley	42 42 17.29	70 53 12.04	307 58 59	Thompson's Hill	128 05 35	16887.2	18467.3	10.49
			14 51 30	Orne's Hill	194 48 34	23266.2	25443.2	14.46
Tilton's Hill	42 40 51.29	70 47 13.34	108 02 21	Prospect Rowley	287 58 17	8584.3	9387.5	5.34
			326 28 11	Thompson's Hill	146 30 44	9297.4	10167.4	5.78
Choate's Hill	42 39 53.65	70 45 19.65	112 26 41	Prospect Rowley	292 21 21	11630.5	12718.8	7.23
			336 55 32	Thompson's Hill	156 56 47	6492.5	7100.0	4.04
Butler's Hill	42 39 27.63	70 39 57.15	104 36 40	Tilton's Hill	284 31 44	10261.6	11221.8	6.37
			96 16 08	Choate's Hill	276 12 29	7387.6	8079.5	4.59
Railcut Hill	42 37 40.99	70 38 37.21	116 35 30	Tilton's Hill	296 29 40	13139.3	14368.8	6.49
			151 02 46	Butler's Hill	331 01 53	3760.4	4012.3	2.34
Poole's Hill	42 39 22.82	70 37 44.58	57 20 03	Thompson's Hill	237 16 10	9297.0	10166.9	5.78
			20 53 30	Railcut Hill	200 52 54	3362.8	3677.5	2.09
Beacon Hill	42 36 09.86	70 38 17.45	187 10 00	Poole's Hill	7 10 21	6000.3	6561.8	3.73
			170 54 10	Railcut Hill	350 53 58	2847.5	3113.9	1.77
Thatcher's Island	42 38 09.08	70 34 25.06	116 36 50	Poole's Hill	296 34 34	5082.1	5557.6	3.16
			81 26 47	Railcut Hill	261 23 56	5809.6	6353.3	3.61

United States Coast Survey.—Geographical Positions. Section I.—Cape Ann. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Thatcher's Island (south light)	42 38 10.95	70 34 10.46	114 28 09	Poole's Hill	294 25 44	5357.3	5858.6	3.33
			80 10 19	Thatcher's Island	260 10 09	337.9	369.5	0.21
Thatcher's Island (north light)	42 38 19.42	70 34 09.83	111 49 01	Poole's Hill	291 46 32	5268.0	5760.9	3.26
			47 24 31	Thatcher's Island	227 24 21	471.4	515.5	0.29
Londoner Spindle	42 38 04.38	70 33 38.13	113 20 36	Poole's Hill	293 17 49	6113.8	6685.9	3.80
			60 59 25	Beacon Hill	240 56 16	7279.4	7960.5	4.57
Milk Island	42 37 39.76	70 35 10.60	56 56 16	Beacon Hill	236 54 09	5081.7	5556.2	3.16
			228 54 46	Thatcher's Island	48 55 17	1376.4	1505.2	0.86
Straitsmouth Island light	42 39 42.50	70 34 57.96	89 55 09	Poole's Hill	260 53 16	3842.9	4202.5	2.39
			124 25 01	Andrews' Point	304 23 21	4074.3	4455.5	2.53
Andrews' Point	42 40 57.12	70 37 25.60	321 34 17	Thatcher's Island	141 36 19	6617.1	7236.3	4.11
			8 26 58	Poole's Hill	188 26 45	2941.5	3216.7	1.83
Annis-squam Light	42 39 41.15	70 40 34.10	103 25 45	Tilton's Hill	283 21 14	9344.2	10218.5	5.81
			93 25 14	Choate's Hill	273 22 01	6513.7	7123.2	4.05
Annis-squam Village (pole on rock.)	42 39 25.05	70 40 18.44	97 21 29	Choate's Hill	277 18 05	6915.6	7562.7	4.30
			324 18 12	Railcut Hill	144 19 21	3952.8	4322.7	2.46
Lane's Cove Church	42 40 39.69	70 38 54.66	91 51 14	Tilton's Hill	271 45 36	11358.2	12221.0	7.06
			89 49 48	Choate's Hill	269 45 27	8879.9	9710.8	5.52
Woodward's Hill	42 36 57.86	70 41 44.78	207 56 22	Butler's Hill	27 57 36	5231.1	5720.6	3.25
			287 22 53	Beacon Hill	107 25 12	4951.8	5415.1	3.08
Gloucester, (Universalist ch.)	42 36 45.77	70 39 38.95	175 15 29	Butler's Hill	355 15 08	5011.0	5479.9	3.11
			219 32 29	Railcut Hill	39 33 11	2209.5	2416.2	1.37

United States Coast Survey.—Geographical Positions. Section I.—Cape Ann. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
East Gloucester Church	42 36 58.57	70 39 04.48	84 35 06	Thompson's Hill	264 32 08	6032.5	6597.0	3.75
			324 30 03	Beacon Hill	144 30 35	1845.9	2018.6	1.15
Clark's Mountain (flag in tree)	42 36 57.63	70 43 20.00	143 37 24	Tilton's Hill................	323 34 45	8956.6	9794.7	5.57
			87 32 25	Brown's Hill................	267 27 34	9782.9	10698.3	6.08
Twopenny Loaf	42 39 34.94	70 42 47.75	9 33 45	Thompson's Hill	189 33 18	5473.8	5983.0	3.40
			301 36 40	Raileut Hill	121 39 39	6702.8	7330.0	4.17
Lufkin's Hill..............	42 38 14.20	70 44 19.71	71 41 17	Brown's Hill................	251 37 07	8361.7	9690.9	5.51
			337 55 08	Thompson's Hill	157 55 43	3135.2	3428.6	1.95
Ipswich East Light.........	42 41 05.68	70 45 38.76	340 01 01	Thompson's Hill	160 02 30	8720.6	9536.6	5.42
			348 55 45	Choate's Hill	168 55 57	2264.8	2476.7	1.41
Ipswich Spire..............	42 40 51.32	70 49 50.60	6 39 56	Brown's Hill................	183 39 30	7686.4	8405.5	4.76
			311 33 20	Thompson's Hill	131 41 39	11664.2	12755.6	7.25
Ipswich West Light	42 41 04.94	70 45 46.17	78 01 24	Tilton's Hill................	258 00 25	2028.6	2218.4	1.26
			38 39 23	Brown's Hill................	218 36 11	10313.9	11279.0	6.41
Burnham Brown	42 39 39.12	70 49 04.74	225 21 24	Tilton's Hill................	45 22 39	3564.5	3898.0	2.22
			261 55 01	Choate's Hill	81 57 33	5176.6	5661.0	3.28
Ten-Pound Island Light.....	42 36 04.78	70 39 36.39	204 25 43	Raileut Hill	24 26 23	3260.5	3565.6	2.03
			265 00 45	Beacon Hill	85 01 38	1806.2	1975.2	1.12
Salt Island, (flag)	42 37 09.52	70 37 05.38	243 16 41	Thatcher's Island............	63 18 33	4088.6	4471.2	2.54
			41 44 45	Beacon Hill	221 43 56	2467.0	2697.8	1.53
Essex, (red top church).....	42 37 58.08	70 46 32.01	170 00 59	Tilton's Hill................	350 00 31	5426.6	5934.4	3.37
			252 53 01	Butler's Hill................	72 57 38	9408.9	10289.3	5.85

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Burnham Essex	42 38 59.62	70 46 43.33	314 02 37	Thompson's Hill	134 04 49	6194.2	6773.8	3.85
			168 47 17	Tilton's Hill	348 46 57	3512.7	3841.4	2.18
Dogtown, (Methodist church)	42 38 02.97	70 40 11.91	187 19 52	Butler's Hill	7 20 02	2633.4	2879.8	1.64
			287 26 41	Railcut Hill	107 27 45	2261.5	2473.1	1.41
Eastern Point Light	42 34 47.24	70 39 32.72	228 21 44	Thatcher's Island	48 25 12	9378.3	10255.8	5.83
			213 56 21	Beacon Hill	33 57 12	3072.9	3360.4	1.91
Rockport, (church with red top.)	42 39 26.93	70 36 48.51	163 07 12	Andrews' Point	243 06 47	2908.1	3180.2	1.81
			306 18 36	Thatcher's Island	126 20 13	4055.4	4434.9	2.52
Salvages	42 40 18.38	70 33 44.74	103 23 44	Andrews' Point	283 21 14	5168.4	5652.0	3.21
			72 35 45	Poole's Hill	252 33 03	5724.1	6259.7	3.56
COAST OF MASSACHUSETTS NORTH OF CAPE ANN.								
Powow Hill	42 51 55.18	70 55 57.76	328 48 02	Thompson's Hill	148 56 31	32985.6	36072.1	20.50
			28 57 37	Holt's Hill	208 50 45	28514.3	31182.4	17.72
Crane Neck	42 46 11.82	70 58 10.70	195 53 47	Powow Hill	15 55 17	11016.1	12046.9	6.84
			271 00 24	Old Town	91 05 30	10251.5	11210.7	6.37
Old Town	42 46 05.74	70 50 39.81	146 12 51	Powow Hill	326 09 15	12977.2	14191.5	8.06
			334 08 56	Tilton's Hill	154 11 16	10779.0	11787.6	6.70
Newburyport, (Harris street church.)	42 48 29.87	70 52 02.66	63 02 41	Crane Neck	242 58 31	9385.8	10264.0	5.83
			7 49 14	Prospect Rowley	187 48 27	11603.3	12689.0	7.21
Newburyport, (Upper Green church.)	42 47 56.71	70 51 25.09	343 16 02	Old Town	163 16 33	3575.6	3910.2	2 22
			70 41 30	Crane Neck	250 36 55	9769.8	10684.0	6.07

United States Coast Survey.—Geographical Positions. Section I.—Coast North of Cape Ann. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Newburyport, (Pleasant street church.)	42 48 36.60	70 51 58.11	339 04 18	Old Town	159 05 11	4983.5	5449.8	3.10
			62 13 09	Crane Neck	242 08 56	9573.1	10468.9	5.95
Belleville Church	42 49 04.94	70 53 03.74	329 22 50	Old Town	149 24 28	6424.2	7025.3	3.99
			52 35 02	Crane Neck	232 31 34	8785.4	9607.5	5.46
Bartlett	42 50 02.63	70 55 02.70	30 58 18	Crane Neck	210 56 10	8304.5	9081.6	5.16
			160 12 30	Powow Hill	340 11 53	3690.7	4036.0	2.29
Byfield Church	42 44 17.17	70 55 32.76	134 34 54	Crane Neck	314 33 07	5040.8	5512.5	3.13
			243 16 36	Old Town	63 19 55	7456.0	8153.7	4.63
Rowley Church	42 42 57.17	70 52 21.29	127 06 53	Crane Neck	307 02 56	9960.3	10892.3	6.19
			201 37 41	Old Town	21 38 50	6259.1	6844.8	3.89
Town Farm, (tree on)	42 43 02.06	70 50 30.99	69 21 50	Prospect Rowley	249 20 01	3916.3	4282.8	2.43
			177 58 31	Old Town	357 58 25	5670.8	6201.4	3.53
Ox Pasture	42 44 15.22	70 52 33.91	13 24 48	Prospect Rowley	193 24 22	3740.7	4090.7	2.32
			115 11 38	Crane Neck	295 07 49	8460.4	9252.0	5.26
Dummer Academy	42 45 14.42	70 53 38.50	353 42 54	Prospect Rowley	173 43 12	5497.5	6011.9	3.42
			167 52 00	Bartlett	347 51 03	9095.7	9946.8	5.65
Rowley Marsh	42 44 35.91	70 49 55.22	331 59 47	Tilton's Hill	152 01 37	7848.3	8582.7	4.88
			159 54 58	Old Town	339 54 28	2951.3	3227.5	1.83
Little Hill, Old Town	42 46 23.03	70 50 11.13	135 40 31	Bartlett	315 37 13	9475.7	10362.4	5.89
			50 42 34	Old Town	230 42 15	842.3	921.1	0.52
Plum Island East Light	42 48 25.10	70 48 40.21	109 08 36	Bartlett	289 04 15	9193.5	10053.7	5.71
			91 51 00	Harris Street Church	271 48 43	4600.8	5031.3	2.86

United States Coast Survey.—Geographical Positions. Section I.—Coast North of Cape Ann. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Plum Island West Light....	42 48 25.08	70 48 45.82	109 24 30	Bartlett..................	289 20 14	9074.1	9873.2	5.64
			91 54 43	Harris Street Church........	271 52 25	4474.2	4892.9	2.78
Plum Island (1)............	42 46 35.20	70 47 56.60	42 03 55	Prospect Rowley............	222 00 26	10713.6	11716.1	6.66
			122 20 54	Harris Street Church........	302 18 07	6616.9	7236.0	4.11
Thompson's Hotel, Plum Island.	42 47 55.32	70 48 27.46	125 56 14	Powow Hill................	305 51 07	12623.0	13804.1	7.84
			352 39 09	Tilton's Hill................	172 39 59	13191.5	14425.8	8.20
Thompson's Flat	42 47 55.34	70 48 27.50	113 40 02	Bartlett..................	293 35 33	9798.5	10715.4	6.09
			192 19 02	Harris Street Church........	282 16 36	5003.1	5471.2	3.11
Wood's Hotel, Plum Island..	42 45 22.01	70 47 54.48	353 36 16	Tilton's Hill................	173 36 44	8405.3	9191.8	5.22
			109 45 39	Old Town.................	289 43 47	3993.4	4367.1	2.48
Plum Island (2)............	42 44 25.95	70 47 12.65	0 08 20	Tilton's Hill................	180 08 19	6623.1	7242.8	4.12
			123 11 33	Old Town.................	303 09 12	5627.3	6153.8	3.50
East end of Barn, Plum Island.	42 43 00.18	70 46 30.38	13 49 21	Tilton's Hill................	193 48 52	4095.2	4478.4	2.54
			135 17 25	Old Town.................	315 14 36	8059.5	8813.6	5.01
Salisbury Church...........	42 50 32.20	70 51 17.89	79 53 51	Bartlett..................	259 51 18	5184.8	5670.0	3.22
			353 59 31	Old Town.................	173 59 57	8267.0	9040.5	5.14
Seabrook.................	42 52 25.76	70 48 45.45	31 24 12	Harris Street Church........	211 21 58	8598.1	9402.6	5.34
			12 26 16	Old Town.................	192 24 58	12070.0	13199.4	7.50
Hampton Falls.............	42 54 42.55	70 53 30.80	302 41 30	Seabrook.................	122 44 45	7694.7	8414.7	4.78
			350 07 17	Harris Street Church........	170 08 17	11671.6	12773.9	7.25
Salisbury Beach............	42 50 47.25	70 48 42.34	17 05 30	Old Town.................	197 04 10	9086.6	9936.8	5.65
			178 42 08	Seabrook.................	358 42 06	3101.5	3391.3	1.93

United States Coast Survey.—Geographical Positions. Section I.—Portsmouth Entrance. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Salisbury Marsh, (flag)	42 51 05.04	70 49 50.56	210 04 19	Seabrook	30 05 03	2949.2	3225.2	1.83
			289 30 48	Salisbury Beach	109 31 34	1643.1	1796.8	1.02
Salisbury Powderhouse	42 51 20.27	70 54 30.30	192 11 46	Hampton Falls	12 12 27	6385.7	6983.2	3.97
			27 45 57	Crane Neck	207 43 27	10753.4	11759.6	6.68
West Salisbury Church	42 50 37.81	70 54 40.15	25 15 16	Bartlett	205 15 01	1200.1	1312.4	0.75
			143 34 47	Powow Hill	323 33 54	2966.9	3244.5	1.84
Batt's Hill	42 52 14.04	70 53 11.52	174 32 48	Hampton Falls	354 32 37	4603.1	5033.8	2.86
			31 54 42	Bartlett	211 53 26	4775.7	5223.6	2.97
Great Boar's Head	42 55 03.61	70 47 24.83	20 50 00	Seabrook	200 49 05	5144.8	5626.2	3.20
			27 27 27	Harris Street Church	207 24 18	13687.4	14968.1	8.50
PORTSMOUTH ENTRANCE.								
Isles of Shoals, Hog Island	42 59 13.06	70 36 29.07	12 52 59	Thompson's Hill	192 48 14	42819.2	46825.8	26.61
			166 19 49	Agamenticus	346 16 36	26990.2	29515.7	16.77
Pulpit Rock	43 01 56.74	70 42 47.14	185 48 24	Agamenticus	5 49 28	21281.3	23272.6	13.22
			300 30 14	Isles of Shoals	120 34 31	9940.0	10870.1	6.18
Newcastle	43 03 35.31	70 42 59.32	354 49 15	Pulpit Rock	174 49 23	3053.8	3339.5	1.90
			312 27 01	Isles of Shoals	132 31 27	11981.0	13102.1	7.44
White Island Light	42 58 00.40	70 37 44.63	199 45 39	Isles of Shoals	19 46 03	2382.4	2605.3	1.48
			168 55 06	Agamenticus	348 52 17	29007.7	31722.0	18.06

United States Coast Survey.—Geographical Positions. Section 1.—Saco River to Cape Elizabeth. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
COAST FROM SACO RIVER TO CAPE ELIZABETH.	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
MOUNT INDEPENDENCE	43 45 32.17	70 18 53.07	60 54 21.3	Ossipee	240 36 56.2	38850.1	42485.3	24.14
			26 55 49.0	Agamenticus	206 40 27.6	66699.8	72895.9	41.44
Fletcher's Neck	43 26 50.90	70 20 11.94	116 00 38	Ossipee	295 44 10	35805.3	39155.6	22.25
			182 55 06	Mount Independence	2 56 00	34646.2	37888.0	21.53
Blue Point Hill	43 33 08.28	70 21 14.72	187 51 28	Mount Independence	7 53 06	23174.5	25342.9	14.40
			353 05 18	Fletcher's Neck	173 06 02	11730.9	12828.6	7.29
Stratten Island	43 30 21.27	70 18 20.17	21 09 41	Fletcher's Neck	201 08 25	6960.9	7612.2	4.32
			142 45 55	Blue Point Hill	322 43 55	6474.7	7080.5	4.02
Grandy Hill	43 33 45.22	70 15 37.72	25 44 55	Fletcher's Neck	205 41 47	14191.8	15519.7	8.82
			30 06 28	Stratten Island	210 04 36	7274.0	7954.6	4.52
Richmond Island	43 32 25.24	70 13 58.62	56 56 46	Stratten Island	236 53 46	7008.9	7664.7	4.35
			137 59 13	Grandy Hill	317 58 05	3322.5	3633.4	2.06
Bramhall's Hill	43 38 46.43	70 16 13.15	164 03 29	Mount Independence	344 01 39	13022.8	14241.4	8.09
			326 10 14	John's Hill	146 12 48	8966.6	9805.6	5.57
Mount Joy	43 35 43.50	70 14 50.95	16 02 29	Grandy Hill	196 01 57	3797.5	4152.8	2.36
			349 07 49	Richmond Island	169 08 25	6229.6	6812.5	3.87
John's Hill	43 34 45.00	70 12 30.64	156 49 13	Mount Independence	336 44 49	21730.8	23764.1	13.50
			75 48 31	Blue Point Hill	255 42 29	12133.1	13268.4	7.54
Saco Church	43 30 01.29	70 26 13.81	305 18 39	Fletcher's Neck	125 52 48	10032.8	10971.6	6.23
			229 18 05	Blue Point Hill	49 21 31	8854.1	9682.6	5.50

United States Coast Survey.—Geographical Positions. Section I.—Saco River to Cape Elizabeth. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Blue Point Hill, (tree)	43 33 06.56	70 21 19.16	352 34 18	Fletcher's Neck	172 35 04	11690.4	12784.3	6.26
			321 44 49	Stratten Island	141 46 53	6493.6	7101.2	4.04
Staples' Boarding-house	43 31 02.85	70 22 21.31	201 06 38	Blue Point Hill	21 07 24	4149.5	4537.8	2.58
			339 29 11	Fletcher's Neck	159 30 40	8300.5	9077.2	5.16
Ram Island, (tall tree)	43 28 00.23	70 21 04.95	330 52 31	Fletcher's Neck	150 53 08	2448.9	2678.0	1.52
			178 40 42	Blue Point Hill	358 40 35	9508.8	10398.5	5.91
Stage Island Monument	43 27 22.82	70 20 45.82	210 42 41	Stratten Island	30 44 21	6405.9	7005.3	3.98
			176 31 06	Blue Point Hill	356 30 46	10680.1	11679.4	6.64
Beacon on pier, mouth of Saco river.	43 27 42.27	70 21 53.18	224 16 10	Stratten Island	44 18 36	6854.3	7495.7	4.26
			184 54 14	Blue Point Hill	4 54 41	10097.2	11042.0	6.27
Biddeford, (tall spire)	43 29 30.13	70 27 11.41	229 55 07	Blue Point Hill	49 59 13	10462.8	11441.8	6.50
			297 29 22	Fletcher's Neck	117 34 11	10631.2	11626.0	6.61
Hubbard's Point, (house)	43 33 19.04	70 17 21.19	17 46 23	Fletcher's Neck	197 44 26	12576.4	13753.2	7.81
			13 34 29	Stratten Island	193 33 48	5643.1	6171.1	3.51
Pool, (cupola of old ware-house.)	43 26 47.28	70 20 59.02	208 22 47	Stratten Island	28 24 36	7506.5	8208.9	4.66
			178 17 04	Blue Point Hill	358 16 53	11762.5	12863.1	7.31
Prout's Neck, (Libby's house)	43 31 53.64	70 18 53.23	125 57 53	Blue Point Hill	305 56 15	3923.3	4290.4	2.44
			345 23 44	Stratten Island	165 24 07	2945.0	3220.6	1.83
Wood Island Light	43 27 23.01	70 19 24.95	166 58 51	Blue Point Hill	346 57 35	10936.4	11959.7	6.79
			218 08 11	Richmond Island	38 11 56	11862.5	12972.5	7.37
Richmond Island, (barn on)	43 32 36.73	70 13 54.98	12 58 05	Richmond Island	192 58 02	364.0	398.1	0.23
			95 40 33	Blue Point Hill	275 35 30	9918.2	10846.3	6.16

United States Coast Survey.—Geographical Positions. Section I.—Saco River to Cape Elizabeth. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Richmond Island, (Dr. Cummings' chimney.)	43 32 37.91	70 14 02.79	95 33 50	Blue Point Hill	275 28 52	9740.5	10651.9	6.05
			346 32 16	Richmond Island	166 32 19	402.1	439.7	0.25
Cape Elizabeth West Light	43 33 49.81	70 11 49.43	48 01 26	Richmond Island	227 59 57	3900.7	4265.7	2.42
			88 26 08	Grandy Hill	268 23 31	5125.0	5604.6	3.18
Cape Elizabeth East Light	43 33 56.30	70 11 40.86	47 44 46	Richmond Island	227 43 11	4177.5	4568.4	2.59
			86 20 27	Grandy Hill	266 17 43	5326.4	5824.8	3.31
Jordan's Barn, (pole on east end.)	43 33 21.85	70 14 10.21	45 13 42	Stratten Island	225 10 49	7908.5	8648.5	4.91
			87 31 32	Blue Point Hill	267 26 39	9536.6	10428.9	5.93
Yellow House, (west base of Grandy hill.)	43 33 24.91	70 15 40.76	32 17 20	Stratten Island	212 15 33	6702.3	7329.4	4.16
			186 13 04	Grandy Hill	6 13 06	630.5	689.5	0.39
Mount Misery	43 35 45.75	70 13 20.94	7 47 07	Richmond Island	187 46 43	6245.1	6829.5	3.88
			65 28 49	Blue Point Hill	245 23 22	11687.5	12781.1	7.26
Munjoy Observatory	43 39 54.04	70 14 34.31	347 42 45	Mount Misery	167 53 36	7837.1	8570.4	4.87
			35 40 51	Blue Point Hill	215 36 15	15407.8	16849.5	9.57
Scottaway Hill, (Waterhouse's house.)	43 35 13.84	70 21 51.01	288 02 38	Grandy Hill	108 06 55	8810.1	9634.5	5.47
			229 04 28	Bramhall's Hill	49 08 21	10020.6	10958.2	6.23
Bennett's House, (Brown's Hill.)	43 38 02.03	70 17 02.33	218 48 26	Bramhall's Hill	38 49 00	1758.5	1923.1	1.09
			32 00 26	Blue Point Hill	211 57 32	10687.2	11687.2	6.64
Spurwink Church	43 34 45.47	70 14 46.80	177 01 30	Mount Joy	357 01 27	1792.7	1960.4	1.11
			225 59 15	Mount Misery	46 00 14	2677.5	2928.0	1.66
Sand Knoll, (opposite Richmond island.)	43 33 12.09	70 15 00.56	316 06 39	Richmond Island	136 07 22	2006.1	2193.8	1.25
			140 47 43	Grandy Hill	320 47 17	1319.7	1443.1	0.82

United States Coast Survey.—Geographical Positions. Section I.—Saco River to Cape Elizabeth. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
High Head Point, (signal) ...	43 33 30.30	70 11 58.75	53 17 05	Richmond Island............	233 15 42	3357.0	3671.1	2.08
			95 22 37	Grandy Hill	275 20 06	4935.5	5397.3	3.07
Ram Island, (signal mouth of Spurwink river.)	43 32 58.77	70 15 16.43	300 37 56	Richmond Island............	120 38 50	2029.9	2219.8	1.26
			161 34 20	Grandy Hill	341 34 06	1511.2	1652.6	0.94

United States Coast Survey.—Geographical Positions. Section II.—Primary Stations. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Fire Island base, (Long Island.) East end	40 40 00.83	73 02 59.60	....	....	....	....	....	....
West end	40 37 47.14	73 12 31.74	252 53 36.6	East Base	72 59 49.3	14059.0	15374.5	8.74
Ruland's Hill	40 50 39.21	73 01 37.99	5 33 35.0	East Base	185 32 41.7	19783.1	21634.2	12.29
			32 50 37.1	West Base	212 43 30.5	28325.3	30975.7	17.60
West Hills	40 48 52.60	73 25 12.25	297 33 43.4	East Base	117 48 13.1	35304.5	38607.9	21.94
			318 55 29.2	West Base	139 03 45.3	27198.5	29743.7	16.90
			264 12 12.9	Ruland's Hill	84 27 37.5	33296.5	36412.0	20.69
Tashua Hill	41 15 35.41	73 14 41.16	338 18 46.5	Ruland's Hill	158 27 20.9	49641.6	54286.5	30.85
			16 39 30.0	West Hills	196 32 35.6	51589.4	56416.6	32.06
Bald Hill	41 12 47.39	73 28 21.61	254 44 45.3	Tashua Hill	74 53 46.1	19794.4	21646.6	12.30
			354 16 26.4	West Hills	174 18 30.7	44476.9	48638.6	27.64
			317 24 59.0	Ruland's Hill	137 42 31.7	55510.4	60704.5	34.49
Harrow	40 47 52.89	73 38 02.17	196 20 42.2	Bald Hill	16 27 03.1	48052.4	52548.7	29.86
			264 06 10.0	West Hills	84 14 33.1	18138.1	19835.3	11.27
Round Hill	41 06 10.65	73 40 05.79	233 13 55.9	Bald Hill	53 21 39.4	20475.6	22391.5	12.72
			355 06 31.4	Harrow	175 07 52.4	33983.3	37163.1	21.12
			326 47 32.4	West Hills	146 57 18.1	38232.5	41869.9	23.75
Buttermilk Hill	41 06 33.91	73 48 18.96	273 31 20.4	Round Hill	93 36 44.6	11528.4	12607.1	7.16
			337 18 04.2	Harrow	157 24 48.4	37465.1	40969.7	23.28
Weasel	40 52 34.18	74 10 52.41	230 33 51.2	Buttermilk Hill	50 48 39.0	40882.9	44708.4	25.40
			280 28 01.6	Harrow	100 49 30.0	46962.6	51356.9	29.18
Beacon Hill	40 22 23.74	74 13 22.06	183 35 24.7	Weasel	3 37 02.1	55949.8	61184.7	34.76
			226 23 36.6	Harrow	46 46 35.7	68622.4	75043.4	42.64

United States Coast Survey.—Geographical Positions. Section II.—Primary Stations. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Springfield	40 41 19.44	74 21 05.44	258 26 30.9	Harrow	78 54 36.9	61803.0	67585.9	38.40
			342 39 56.7	Beacon Hill	162 44 57.8	36685.8	40118.5	22.80
Disboro'	40 14 45.43	74 27 06.10	189 46 18.1	Springfield	9 50 12.2	49891.0	54559.3	31.00
			233 55 39.3	Beacon Hill	54 04 32.3	24048.4	26298.6	14.94
Mount Rose	40 22 00.56	74 43 06.14	220 53 27.8	Springfield	41 07 46.1	47366.7	51798.8	29.43
			300 32 22.8	Disboro'	120 42 43.8	26342.5	28807.4	16.37
			268 51 57.9	Beacon Hill	89 11 13.5	42091.3	46029.8	26.15
Stony Hill	40 07 09.59	75 34 33.06	156 14 04.5	Mount Rose	336 08 33.1	30034.9	32845.3	18.66
			216 54 16.5	Disboro'	36 59 04.9	17590.5	19236.5	10.93
Newtown	40 15 00.50	74 54 54.37	232 10 12.8	Mount Rose	52 17 50.9	21153.1	23132.4	13.14
			296 34 50.2	Stony Hill	116 47 58.2	32333.9	35359.4	20.09
Mount Holly	40 00 06.12	74 46 59.70	187 44 22.8	Mount Rose	7 46 53.5	40912.6	44740.8	25.42
			233 30 05.5	Stony Hill	53 38 06.0	21990.8	23998.5	13.66
			157 52 33.6	Newtown	337 47 27.7	29784.1	32571.0	18.51
Willow Grove	40 08 28.97	75 06 02.79	299 41 34.4	Mount Holly	119 53 50.2	31209.1	34128.7	19.39
			232 33 57.4	Newtown	52 41 08.8	19892.3	21753.6	12.36
Pine Hill	39 47 51.03	74 59 16.50	217 36 08.5	Mount Holly	37 44 01.1	28639.0	31318.7	17.80
			165 51 49.9	Willow Grove	345 47 28.9	39375.9	43060.3	24.47
Yard	39 58 21.75	75 22 54.41	266 12 16.0	Mount Holly	86 35 20.6	51215.8	56008.1	31.82
			299 52 35.0	Pine Hill	120 07 44.2	38898.4	42538.1	24.17
Bethel	39 50 43.14	75 29 05.98	276 57 01.7	Pine Hill	97 16 07.7	42882.8	46895.3	26.65
			211 55 43.7	Yard	31 59 42.1	16670.5	18230.4	10.36

United States Coast Survey.—Geographical Positions. Section II.—Primary Stations. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Lippencott	39 43 17.44	75 18 30.36	132 19 20.0	Bethel	312 12 33.3	20435.9	22348.1	12.70
			167 20 21.4	Yard	347 17 32.2	28585.5	31260.3	17.76
			252 49 10.9	Pine Hill	73 01 29.0	28729.6	31417.8	17.85
Burden	39 31 45.74	75 22 33.40	165 06 10.7	Bethel	345 02 00.0	36300.7	39697.4	22.55
			195 10 47.2	Lippencott	15 13 22.2	22103.8	24172.1	13.74
Meetinghouse Hill	39 42 43.12	75 42 20.85	268 05 37.3	Lippencott	88 20 51.3	34084.4	37273.7	21.18
			305 29 29.8	Burden	125 42 07.0	34826.9	38085.6	21.64
Buck	39 32 23.56	75 43 35.89	272 06 14.9	Burden	92 19 38.6	30168.4	32991.3	18.74
			185 20 39.4	Meetinghouse Hill	5 21 27.2	19189.3	20984.9	11.92
Principio	39 35 33.46	75 59 57.25	242 09 19.4	Meetinghouse Hill	62 20 33.5	28455.2	31117.8	17.68
			283 57 01.2	Buck	104 07 26.3	24143.4	26402.5	15.00
Deakyne	39 22 49.69	75 31 23.39	217 25 20.0	Burden	37 30 56.8	20826.9	22775.7	12.94
			135 22 08.3	Buck	315 14 22.7	24894.5	27023.9	15.47
Pine Mount	39 25 00.57	75 19 56.46	163 18 14.0	Burden	343 16 34.2	13044.9	14265.5	8.11
			76 15 48.5	Deakyne	256 08 32.5	16922.9	18506.4	10.51
Deep Water	39 11 51.33	75 22 52.73	148 57 55.7	Deakyne	328 52 32.3	23703.8	25921.8	14.73
			189 49 39.9	Pine Mount	9 51 31.5	24700.7	27011.9	15.34
Joscelyne	39 18 37.02	75 08 03.49	124 47 10.0	Pine Mount	304 39 37.8	20763.9	22706.8	12.90
			59 40 26.6	Deep Water	239 31 03.9	24717.9	27030.7	15.36

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
LONG ISLAND SOUND.								
Principal Series.	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Friar's Head	40 58 13.42	72 43 20.97	61 28 37.2	Ruland's Hill	241 16 38.8	29245.5	31982.0	18.17
			126 24 19.4	Tashua Hill	306 03 43.0	54376.0	59463.9	33.79
Mount Carmel	41 25 49.46	72 53 05.34	57 57 23.6	Tashua Hill	237 43 07.6	35582.2	38911.6	22.11
			10 27 14.7	Ruland's Hill	190 21 37.4	66179.6	72372.0	41.12
Sugarloaf	41 22 39.51	72 43 34.61	73 46 26.3	Tashua Hill	253 25 54.0	45248.7	49482.6	28.12
			359 35 35.6	Friar's Head	179 35 44.6	44915.5	49118.2	27.91
Williams	41 21 16.62	72 30 49.11	22 24 03.1	Friar's Head	202 15 48.2	46125.3	50441.2	28.66
			97 16 28.2	Sugarloaf	277 08 02.3	17931.1	19608.9	11.14
Shelter Island	41 04 36.59	72 21 19.22	69 10 29.1	Friar's Head	248 56 01.6	33061.0	36154.5	20.54
			156 46 08.9	Williams	336 39 53.4	33581.8	36724.1	20.87
Nickerson	41 23 51.55	72 19 19.01	4 30 11.6	Shelter Island	184 28 52.4	35736.1	39079.9	22.21
			73 27 59.2	Williams	253 20 23.1	16731.5	18295.5	10.40
Montauk	41 03 52.01	71 53 57.65	136 23 03.1	Nickerson	316 06 20.4	51226.6	56019.9	31.83
			92 12 17.6	Shelter Island	271 54 19.1	38344.2	41932.1	23.83
Lantern Hill	41 27 35.67	71 56 20.11	355 40 09.3	Montauk	175 41 43.3	44039.9	48160.7	27.36
			77 56 24.5	Nickerson	257 41 12.1	32751.1	35815.9	20.35
Beacon Hill (Block Island)	41 10 29.75	71 35 49.74	65 06 09.5	Montauk	244 53 47.7	29029.6	31745.9	18.04
			137 05 04.2	Lantern Hill	316 51 05.4	43293.0	47343.9	26.90
Champlin	41 29 13.76	71 46 26.97	77 39 13.1	Lantern Hill	257 32 40.3	14089.7	15408.1	8.75
			335 30 45.9	Beacon Hill	155 38 13.1	38079.9	41643.0	23.66

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United States Coast Survey.—Geographical Positions. Section II.—Rhode Island and Connecticut. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
McSparran Hill	41 29 44.72	71 27 03.80	83 04 46.8	Champlin	267 51 56.2	26095.2	29521.1	16.77
			17 38 21.4	Beacon Hill	197 33 00.5	37375.3	40872.5	23.22
East Rock	41 27 02.41	71 11 17.31	102 55 53.0	McSparran Hill	282 45 26.1	22522.1	24629.5	13.99
			47 32 41.0	Beacon Hill	227 16 55.4	45249.0	49482.9	28.12
RHODE ISLAND AND CONNECTICUT.								
Point Judith to Stonington.								
Tiff's Hill	41 27 46.33	71 31 54.79	8 05 16	Beacon Hill	188 03 07	32296.0	35317.9	20.07
			97 40 19	Champlin	277 30 42	20413.7	22323.8	12.69
Broadhill	41 24 37.69	71 33 21.94	115 07 25	Champlin	294 58 45	20111.8	21993.7	12.50
			222 46 57	McSparran Hill	42 51 07	12912.0	14120.2	8.02
Watch Hill	41 18 47.64	71 50 56.44	8 42 23	Montauk	188 40 24	27948.7	30564.4	17.37
			304 46 55	Beacon Hill	124 57 19	26865.1	29378.9	16.69
Austin	41 24 23.02	71 28 23.96	93 46 08	Broad Hill	273 42 51	6935.1	7584.0	4.31
			190 36 36	McSparran Hill	10 37 29	10096.7	11041.5	6.27
Point Judith	41 21 52.55	71 28 57.00	189 23 16	Austin	9 23 38	4704.8	5145.0	2.92
			129 38 20	Broad Hill	309 35 24	7989.6	8737.2	4.96
Point Judith Light	41 21 37.63	71 28 33.74	24 08 18	Beacon Hill	204 03 57	22570.2	24682.1	14.03
			80 35 19	Watch Hill	260 20 32	31654.8	34616.7	19.67
Weeden	41 22 48.62	71 32 54.34	169 13 00	Broad Hill	349 12 42	3425.3	3745.8	2.13
			245 05 59	Austin	65 08 58	6923.1	7570.9	4.30

United States Coast Survey.—Geographical Positions. Section II.—Rhode Island and Connecticut. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Kingston Spire	41 28 46.66	71 31 12.66	92 20 30	Champlin	272 10 24	21226.3	23212.4	13.19
			21 21 14	Broad Hill	201 19 48	8245.7	9015.3	5.12
Meeting-house Hill	41 26 43.09	71 28 12.99	17 55 50	Beacon Hill	197 51 15	31550.9	34500.1	19.60
			110 46 50	Tiff's Hill	290 44 23	5504.6	6019.7	3.42
Boston Neck	41 28 16.86	71 25 44.49	50 00 16	Meeting-house Hill	229 58 38	4499.4	4920.4	2.80
			145 50 37	McSparran Hill	325 49 44	3276.1	3582.7	2.04
Tower Hill Spire	41 28 00.62	71 27 14.28	18 52 41	Beacon Hill	198 47 27	34250.9	37455.7	21.28
			86 09 06	Tiff's Hill	266 05 59	6523.7	7134.1	4.05
Newport Spire	41 29 12.23	71 18 28.71	34 00 06	Beacon Hill	213 49 05	41721.9	45596.0	25.92
			82 00 36	Tiff's Hill	261 51 42	13888.1	20655.5	11.74
Sherman	41 30 14.74	71 30 35.10	21 59 50	Tiff's Hill	201 58 57	4937.4	5399.4	3.07
			85 13 05	Champlin	265 02 34	22156.7	24229.9	13.77
Wakefield, (flag-staff)	41 26 02.78	71 30 19.14	213 29 18	McSparran Hill	33 31 27	8211.2	8979.5	5.10
			246 59 08	Meeting-house Hill	67 00 32	3181.2	3478.9	1.98
Shannock	41 28 03.00	71 38 00.69	314 21 27	Broad Hill	134 24 32	9054.5	9901.7	5.63
			230 11 32	Meeting-house Hill	100 18 01	13860.0	15156.9	8.61
Wilbur	41 29 27.39	71 38 11.68	87 57 02	Champlin	267 51 34	11496.2	12571.9	7.14
			323 00 46	Broad Hill	143 03 58	11184.1	12230.6	6.95
Wilcox	41 21 20.87	71 43 39.02	329 24 30	Beacon Hill	149 30 06	23323.3	25505.7	14.49
			65 06 17	Watch Hill	245 01 28	11215.1	12264.5	6.96
James	41 32 39.59	71 39 32.08	15 19 53	Wilcox	195 17 09	21707.5	23738.7	13.49
			56 36 36	Champlin	236 32 01	11526.0	12604.5	7.16

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Green Hill	41 22 22.41	71 35 30.68	358 43 41	Beacon Hill	178 43 55	21900.2	23949.4	13.61
			80 33 12	Wilcox	260 27 50	11506.5	12583.2	7 15
Joshua Champlin	41 22 14.12	71 39 34.47	344 08 44	Beacon Hill	164 11 39	22585.0	24698.3	14.03
			267 23 10	Green Hill	87 25 51	5670.7	6201.3	3.52
Noyes' Point	41 19 44.02	71 44 58.60	321 13 36	Beacon Hill	141 20 05	21916.0	23966.1	13.62
			211 45 15	Wilcox	31 46 07	3514.6	3842.9	2.18
Quanacontog	41 19 57.68	71 42 16.47	83 37 44	Noyes' Point	263 35 57	3793.5	4148.5	2.36
			143 13 53	Wilcox	323 12 58	3204.9	3504.8	1 99
Sand Hill	41 21 33.30	71 41 56.53	77 17 45	Wilcox	257 16 37	2441.9	2670.4	1.52
			8 29 51	Quanacontog	188 29 38	3139.0	3432.7	1.95
Block Island Light-house	41 13 26.84	71 34 12.19	57 25 49	Montauk	237 12 49	32841.3	35914.3	20.41
			113 02 24	Watch Hill	292 51 21	25381.0	27755.9	15.77
Bushy Hill	41 12 41.67	71 33 19.66	32 14 09	Beacon Hill	212 12 56	4810.4	5260.0	2.99
			114 45 01	Watch Hill	294 33 24	27065.0	29597.5	16.82
Eell's Hill, (2)	41 22 47.59	71 50 43.61	2 18 12	Watch Hill	182 18 03	7408.2	8101.4	4.60
			138 42 27	Lantern Hill	318 38 44	11833.8	12941.1	7.35
Peleg Tiff	41 23 16.45	71 48 19.64	23 44 17	Watch Hill	203 42 33	9058.6	9906.2	5.63
			298 38 29	Wilcox	118 41 34	7431.0	8126.4	4.62
Cranberry Hill	41 20 50.91	71 47 01.97	258 53 32	Wilcox	78 55 46	4806.8	5256.6	2.99
			158 06 26	Peleg Tiff	338 05 35	4838.4	5291.1	3.91
Cormorant Hill	41 23 34.93	71 48 42.67	62 32 51	Eell's Hill, (2)	242 31 29	3166.7	3463.0	1.97
			316 48 29	Peleg Tiff	136 48 46	781.9	855.1	0.49

United States Coast Survey.—Geographical Positions. Section II.—Rhode Island and Connecticut. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Big Hill	41 23 34.06	71 45 47.69	20 04 41	Cranberry Hill	200 03 52	5029.5	5500.1	3.13
			86 12 22	Peleg Tiff	266 10 42	3537.4	3868.4	2.20
Wells' Hill	41 25 54.36	71 44 55.13	14 45 18	Big Hill	194 44 43	4794.2	5242.8	2.98
			44 17 32	Peleg Tiff	224 15 17	6803.0	7469.6	4.33
Diamond Hill, (tree)	41 25 44.26	71 46 07.92	353 47 52	Big Hill	173 48 05	4349.9	4756.9	2.70
			33 52 06	Peleg Tiff	213 50 39	5490.3	6004.0	3.41
Quacatog	41 23 13.01	71 56 37.87	182 54 32	Lantern Hill	2 54 44	8113.2	8872.4	5.04
			275 24 41	Eell's Hill, (2)	95 28 36	8267.8	9041.4	5.14
Grant's Hill	41 25 22.90	71 53 45.35	138 46 02	Lantern Hill	318 44 20	5447.2	5956.9	3.39
			45 00 17	Quacatog	224 58 23	5665.7	6195.8	3.52
North Stonington	41 25 57.30	71 50 59 92	356 17 49	Eell's Hill, (2)	176 17 57	5864.3	6413.0	3.64
			323 06 18	Peleg Tiff	143 08 06	6202.8	6783.2	3.85
Jesse Main	41 26 29.36	71 48 54.25	73 09 03	Grant's Hill	253 05 50	7062.2	7723.0	4.39
			20 22 42	Eell's Hill, (2)	200 21 30	7297.8	7980.7	4.53
Chapman's Hill	41 29 29.95	71 51 19.83	63 11 10	Lantern Hill	243 07 51	7806.9	8537.4	4.85
			23 54 53	Grant's Hill	203 53 17	8335.5	9115.5	5.18
Road Meeting-house	41 22 21.14	71 54 30.49	322 54 30	Watch Hill	142 56 51	8255.0	9027.4	5.13
			261 10 45	Eell's Hill, (2)	81 13 15	5334.2	5833.3	3.32
Mount Prospect, (Fisher's Island.)	41 15 19.18	72 00 15.22	193 30 07	Lantern Hill	13 32 43	23366.5	25552.9	14.52
			337 24 55	Montauk	157 29 03	22951.0	25098.5	14.26
Watch Hill Light	41 18 11.42	71 51 11.49	197 23 45	Watch Hill	17 23 55	1171.0	1280.6	0.73
			67 16 10	Mount Prospect	247 10 48	13723.0	15007.1	8.53

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Fort Hill	41 20 45.42	72 00 20.00	285 26 42	Watch Hill	105 32 54	13598.1	14870.5	8.45
			359 21 59	Mount Prospect	179 22 02	10062.7	11044.3	6.25
Chocomount	41 16 45.75	71 57 27.32	151 29 48	Fort Hill	331 27 54	8413.3	9200.5	5.23
			247 30 05	Watch Hill	67 34 23	9838.9	10759.5	6.11
East End	41 17 03.95	71 55 43.20	62 59 13	Mount Prospect	242 56 14	7108.0	7773.1	4.42
			136 43 31	Fort Hill	316 40 29	9387.0	10265.3	5.83
Wampasset Point	41 19 42.36	71 54 56.18	104 30 54	Fort Hill	284 27 20	7776.0	8503.6	4.83
			32 50 59	Chocomount	212 49 05	6484.0	7090.7	4.22
Wicopisset	41 17 37.84	71 54 31.49	246 41 33	Watch Hill	66 43 55	5446.1	5955.7	3.39
			171 29 52	Wampasset Point	351 29 36	3884.0	4247.4	2.41
Stonington,* (new light-house)	41 19 38.73	71 54 00.17	0 00	Stonington Old Light	180 00	61.7	67.5	0.04
Stonington, (old light-house)	41 19 36.73	71 54 00.17	289 30 06	Watch Hill	109 32 07	4534.0	4958.3	2.82
			42 25 44	Chocomount	222 23 27	7160.0	7829.9	4.45
Mystic Light-house	41 18 57.08	71 59 02.51	53 20 02	Groton Long Point	233 19 24	1684.0	1841.6	1.05
			331 19 26	Chocomount	151 20 29	4617.0	5049.0	2.87
LONG ISLAND SOUND.								
Thames River.								
Avery's Point	41 18 55.29	72 03 31.90	325 30 39	Mount Prospect	145 32 49	8086.0	8843.6	5.03
			232 42 02	Fort Hill	52 44 09	5608.0	6162.7	3.49
Groton Long Point	41 18 24.49	72 00 00.58	3 24 44	Mount Prospect	183 24 34	5726.0	6261.8	3.56
			100 57 26	Avery's Point	280 55 07	5006.0	5474.4	3.11

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
North Hammock	41 17 14.37	72 00 50.58	346 57 00	Mount Prospect	166 57 23	3647.0	3982.2	2.27
			280 33 40	Chocomount	100 35 54	4811.0	5261.2	2.99
North Hill	41 16 21.04	72 01 05.91	328 15 21	Mount Prospect	148 15 54	2243.3	2455.2	1.40
			261 27 41	Chocomount	81 30 05	5143.0	5624.2	3.20
Race Point	41 15 01.41	73 01 57.74	257 03 04	Mount Prospect	77 04 12	2449.0	2678.2	1.52
			206 08 56	North Hill	26 09 30	2737.0	2993.1	1.69
Goshen Point	41 17 55.33	72 06 27.27	299 03 18	Mount Prospect	119 07 23	9907.2	10834.2	6.16
			238 24 21	Fort Hill	58 28 23	10022.9	10960.7	6.23
Race Rock Spindle	41 14 34.46	72 02 30.35	138 21 26	Goshen Point	318 18 50	8295.0	9071.2	5.15
			246 18 27	Mount Prospect	66 19 56	3435.0	3756.4	2.14
New London Light-house	41 18 57.66	72 05 04.07	315 03 43	Mount Prospect	135 06 54	9519.0	10409.7	5.92
			10 30 17	Gull Island	190 29 10	12975.8	14190.0	8.06
Vinegar Hill	41 25 25.09	72 03 00.87	348 20 33	Mount Prospect	168 22 22	19083.0	20868.6	11.86
			246 32 58	Lantern Hill	66 37 23	10136.9	11085.4	6.30
Browning	41 25 03.28	72 06 02.98	335 48 01	Mount Prospect	155 51 51	19748.6	21596.5	12.27
			250 47 15	Lantern Hill	70 53 41	14323.6	15663.9	8.90
Quaker	41 22 44.07	72 06 05.40	329 16 53	Mount Prospect	149 20 44	15957.8	17451.0	9.92
			220 46 26	Vinegar Hill	40 48 28	6560.8	7174.7	4.08
Manetuck	41 21 13.26	72 08 42.54	312 44 24	Mount Prospect	132 49 59	16078.9	17583.4	9.99
			232 29 22	Quaker	52 31 06	4601.9	5032.5	2.86
New London, (Presbyterian church spire.)	41 21 16.31	72 05 29.38	88 48 59	Manetuck	268 46 51	4490.4	4910.6	2.79
			162 48 48	Quaker	342 48 24	2833.7	3098.9	1.76

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Fort Trumbull, (flag-staff.)	41 20 35.98	72 05 18.50	103 38 51	Manetuck	283 36 36	4880.1	5336.7	3.03
			164 34 39	Quaker	344 34 08	4098.8	4482.3	2.55
Groton Monument	41 21 15.72	72 04 26.81	89 17 29	Manetuck	269 14 40	5944.1	6500.4	3.69
			139 57 12	Quaker	319 56 07	3560.5	3893.7	2.21
Tory Hill	41 31 02.19	72 03 44.67	354 24 48	Vinegar Hill	174 25 17	10448.4	11426.1	6.49
			301 40 05	Lantern Hill	121 44 59	12121.0	13225.2	7.53
Pole's Hill	41 27 12.25	72 07 20.94	298 40 45	Vinegar Hill	118 43 37	6882.8	7526.8	4.28
			215 14 57	Tory Hill	35 17 20	8687.9	9500.8	5.40
Mohican Spire	41 28 21.60	72 05 34.65	3 55 33	Quaker	183 55 13	10436.5	11413.1	6.49
			326 44 22	Vinegar Hill	146 46 04	6510.4	7119.6	4.05
Gull Island	41 12 04.07	72 06 45.57	236 27 27	Mount Prospect	56 31 44	1090.2	1192.2	0.68
			170 53 05	Manetuck	350 51 48	1715.8	1876.4	1.07
Long Island Sound.								
Sachem's Head	41 16 56.20	72 43 10.40	244 56 49	Williams	65 04 59	19018.8	20798.4	11.82
			176 52 04	Sugarloaf	356 51 48	10297.3	11260.8	6.40
Hammonasset	41 14 53.58	72 32 19.95	190 07 53	Williams	10 08 53	12002.7	13125.8	7.46
			131 55 53	Sugarloaf	311 48 27	21071.5	23045.3	13.09
Mattituck Hills	41 00 06.03	72 34 09.20	74 58 44	Friar's Head	354 52 42	13355.0	14604.6	8.30
			158 00 04	Sachem's Head	337 54 08	33618.9	36764.6	20.89
Horton's Point	41 04 55.80	72 26 33.07	50 02 33	Mattituck Hills	229 57 33	13906.6	15207.8	8.65
			156 21 13	Hammonasset	336 17 25	20133.9	22017.8	12.51

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Cornfield Point	41 15 39.86	72 22 53.76	83 52 12	Hammonasset	263 46 00	13258.0	14498.6	8.24
			14 26 57	Horton's Point	194 24 33	20515.1	22434.7	12.75
Brown's Hill	41 09 08.91	72 17 15.87	59 03 30	Horton's Point	238 57 23	15163.6	16582.5	11.42
			116 51 56	Hammonasset	296 42 00	23593.6	25801.3	14.66
Hatchett's Point	41 16 56.48	72 15 22.96	77 20.46	Cornfield Point	257 15 48	10754.8	11661.4	6.68
			10 20 39	Brown's Hill	190 19 25	14661.4	16033.5	9.11
Gardiner's Island	41 06 03.21	72 06 01.64	205 10 39	Mount Prospect	25 14 26	18954.5	20728.1	7.31
			283 24 12	Montauk	103 32 08	17374.7	19000.9	10.80
Black Point	41 17 07.36	72 11 59.12	337 50 34	Gardiner's Island	157 54 29	22116.5	24185.9	13.74
			26 35 19	Brown's Hill	206 31 50	16500.6	18044.6	10.26
Two-tree Island	41 17 38.49	72 08 51.34	181 46 21	Manetuck	1 46 27	6628.0	7248.2	4.12
			77 37 24	Black Point	257 35 20	4473.0	4891.5	2.78
Millstone Point	41 18 16.60	72 09 33.79	57 44 05	Black Point	237 42 29	3999.0	4373.2	2.49
			341 10 07	Gull Island	161 11 44	12140.4	13276.4	7.54
Plum Island	41 11 03.51	72 10 33.65	69 22 35	Brown's Hill	249 18 11	10019.5	10957.0	6.23
			325 34 32	Gardiner's Island	145 37 31	11226.1	12336.5	6.97
Gull Island Light-house	41 12 20.65	72 06 05.12	359 36 18	Gardiner's Island	179 36 20	11642.6	12733.0	7.23
			69 12 37	Plum Island	249 09 43	6694.6	7321.0	4.15
Great Gull Island, (2)	41 12 04.04	72 06 45.84	354 42 27	Gardiner's Island	174 42 57	11178.4	12224.4	6.95
			70 38 26	Plum Island	250 35 56	5627.1	6153.6	3.50
Four-mile River	41 18 09.85	72 15 52.82	311 28 48	Gull Island	131 34 50	17017.4	18609.7	6.66
			283 28 51	Mount Prospect	103 39 10	22443.1	24543.1	13.95

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Plum Island Light-house	41 10 23.29	72 12 22.31	71 39 36	Brown's Hill	251 26 23	7217.0	7892.3	4.48
			161 22 46	Four-mile River	341 10 38	15203.0	16625.5	9.45
Connecticut River.								
Malicah	41 20 32.83	72 19 48.68	186 24 51	Nickerson	6 25 11	6168.3	6745.5	3.83
			95 05 19	Williams	274 58 03	15410.9	16852.9	9.58
Essex	41 20 31.02	72 23 28.57	223 07 52	Nickerson	43 10 37	8478.9	9272.3	5.27
			269 21 15	Malicah	89 23 41	5112.3	5590.7	3.18
Pettipang Spire	41 21 03.60	72 24 32.87	234 35 01	Nickerson	54 38 29	8945.4	9782.4	5.56
			278 09 08	Malicah	98 12 16	6674.0	7298.5	4.15
Ely	41 21 49.15	72 22 06.68	306 16 00	Malicah	126 17 31	3979.0	4351.3	2.47
			38 18 28	Essex	218 17 34	3071.3	3358.7	1.91
Essex Spire	41 21 09.38	72 23 15.45	283 10 51	Malicah	103 13 08	4936.8	5398.7	3.07
			14 27 59	Essex	194 27 50	1221.9	1336.2	0.76
Ferry Hill	41 18 55.58	72 21 36.44	199 16 15	Nickerson	19 17 46	9672.4	10577.5	6.01
			138 29 00	Essex	318 27 46	3932.8	4300.8	2.44
Bog-hole Hill	41 18 47.40	72 18 36.32	93 27 36	Ferry Hill	273 25 37	4196.7	4589.4	2.61
			173 57 59	Nickerson	353 57 31	9434.2	10317.0	5.86
Lay's Hill	41 16 55.89	72 17 41.51	169 58 42	Nickerson	349 57 38	13020.3	14238.6	8.09
			124 03 13	Ferry Hill	304 00 38	6596.0	7223.2	4.10
Beacon Hill	41 17 32.28	72 23 48.34	208 07 47	Nickerson	28 10 45	13269.2	14512.8	8.24
			252 15 51	Bog-hole Hill	72 19 17	7619.1	8332.0	4.73

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Lyme Spire	41 18 44.09	72 19 35.53	39 04 50	Cornfield Point	219 02 39	7319.6	8004.6	4.55
			349 36 01	Brown's Hill	169 37 33	18039.0	19726.9	11.21
Saybrook Spire	41 17 09.95	72 22 13.56	334 55 44	Brown's Hill	154 59 00	16378.9	17911.5	10.18
			73 27 24	Hammonasset	253 20 44	14727.2	16105.2	9.15
Saybrook Old Light-house	41 16 15.24	72 20 16.40	115 44 01	Beacon Hill	295 41 41	5474.0	5986.2	3.40
			73 25 01	Cornfield Point	253 23 17	3822.0	4179.6	2.37
Saybrook New Light-house	41 16 14 98	72 20 16.42	115 50 01	Beacon Hill	295 46 20	5477.3	5989.8	3.40
			73 31 55	Cornfield Point	253 30 11	3819.0	4176.4	2.37
North side of Long Island Sound, from Connecticut River to Housatonic River.								
High Hill	41 20 35.22	72 37 21.54	326 19 03	Hammonasset,	146 22 22	12659.9	13844.5	7.87
			50 14 58	Sachem's Head	230 11 07	10558.0	11545.9	6.56
Murdock	41 17 08.13	72 28 00.43	55 31 44	Hammonasset	235 28 53	7328.5	8014.2	4.55
			116 08 01	High Hill	296 01 50	14529.2	15888.7	8.03
North Killingworth Spire	41 21 44.75	72 33 37.62	351 53 11	Hammonasset	171 54 02	12810.8	14009.5	7.96
			282 28 47	Williams	102 30 38	4011.5	4386.9	2.49
Pachaag, (West Brook spire.)	41 17 08.28	72 26 40.23	318 18 48	Brown's Hill	138 25 00	19785.8	21637.2	12.29
			62 18 27	Hammonasset	242 14 43	8932.5	9768.3	5.55
Duck Island	41 15 21.29	72 28 12.66	81 34 39	Hammonasset	261 31 56	5820.0	6364.6	3.62
			161 38 50	Williams	341 37 07	11548.8	12629.4	7.18

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Great Hammock	41 15 32.85	72 30 22.86	66 03 09	Hammonasset	246 01 52	2982.7	3261.8	1.85
			133 48 00	High Hill	313 43 24	13485.0	14746.8	8.38
Long Hill	41 17 23.97	72 30 26.60	29 38 11	Hammonasset	209 36 56	5336.5	5835.8	3.32
			358 32.44	Great Hammock	178 32 46	3428.8	3749.6	2.13
Horse Pond	41 17 33.82	72 35 00.46	322 54 21	Hammonasset	142 56 07	6195.5	6775.2	3.85
			272 42 19	Long Hill	92 45 20	6378.6	6975.5	3.96
Camp's Hill	41 16 28.03	72 33 52.96	323 22 43	Hammonasset	143 23 44	3629.8	3969.4	2.26
			289 10 34	Great Hammock	109 12 53	5177.6	5662.1	3.22
Cow Hill	41 17 42.02	72 32 09.16	2 45 51	Hammonasset	182 45 44	5201.7	5688.4	3.23
			328 09 15	Great Hammock	148 10 25	4690.1	5129.0	2.91
Clinton Spire	41 16 40.30	72 31 04.04	28 13 56	Hammonasset	208 13 06	3736.4	4086.0	2.32
			106 43 26	Horse Pond	286 40 50	5743.3	6280.7	3.57
Tucks' Island	41 15 55.51	72 35 47.88	291 31 07	Hammonasset	111 33 24	5203.5	5690.4	2.23
			165 50 17	High Hill	345 49 15	8898.7	9731.4	5.53
Hogshead Point	41 16 08.22	72 37 54.83	286 25 21	Hammonasset	106 29 02	8127.9	8888.4	5.05
			185 22 07	High Hill	5 22 29	8272.4	9046.4	5.14
Griswold	41 17 27.86	72 39 15.85	296 08 35	Hammonasset	116 13 09	10785.9	11795.1	6.70
			204 41 30	High Hill	24 42 46	6361.5	6956.7	3.94
Mulberry Point	41 15 35.12	72 40 35.08	276 17 56	Hammonasset	96 23 23	11596.7	12681.8	7.21
			205 55 03	High Hill	25 57 11	10293.4	11256.6	6.40
Hungry Hill	41 18 47.51	72 41 12.64	300 09 25	Hammonasset	120 15 17	14342.6	15684.6	8.91
			238 15 08	High Hill	58 17 41	6317.7	6908.9	3.93

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Graves	41 17 50.46	72 36 31.21	167 02 05	High Hill	347 01 32	5215.2	5703.2	3.24
			105 04 24	Hungry Hill	285 01 18	6778.7	7413.0	4.21
Bartlett	41 14 51.71	72 42 24.45	269 42 32	Hammonasset	89 49 11	14073.2	15390.0	8.74
			164 26 36	Sachem's Head	344 26 06	3986.1	4359.1	2.48
Madison Spire	41 16 42.43	72 35 47.91	163 08 15	High Hill	343 07 13	7503.7	7205.8	4.66
			117 05 06	Hungry Hill	297 01 32	8482.8	9276.5	5.27
Moose Hill	41 18 20.19	72 44 13.81	246 28 43	High Hill	66 33 15	10452.9	11431.2	6.50
			339 20 02	Sachem's Head	150 20 44	2981.3	3260.3	1.85
Setauket	41 19 34.11	72 46 11.76	319 05 21	Sachem's Head	139 07 21	6443.9	7046.9	4.01
			261 16 30	High Hill	81 21 20	12471.1	13637.9	7.75
Plant	41 16 36.71	72 50 09.53	266 26 00	Sachem's Head	86 30 36	9771.4	10685.7	6.07
			225 16 57	Setauket	45 19 34	7780.6	8308.6	4.83
Indian Neck	41 15 21.41	72 48 59.45	250 10 19	Sachem's Head	70 14 09	8633.7	9441.6	5.37
			206 34 20	Setauket	26 36 11	8716.8	9532.4	5.42
Barker	41 15 13.44	72 48 13.89	245 48 09	Sachem's Head	65 51 29	7741.9	8466.0	4.81
			199 27 01	Setauket	19 28 22	8528.2	9325.2	5.30
Hoadley's Point	41 15 25.13	72 43 49.68	104 03 25	Plant	283 59 14	9112.2	9964.8	5.66
			198 01 12	Sachem's Head	18 01 38	2954.2	3230.6	1.84
Stony Creek	41 16 20.92	72 45 00.92	247 02 59	Sachem's Head	67 04 12	2792.8	3054.1	1.74
			196 35 04	Moose Hill	16 35 35	3839.0	4198.2	2.39
Page 3	41 19 20.55	72 47 51.58	304 13 11	Sachem's Head	124 16 17	7912.5	8652.9	4.92
			32 25 30	Plant	212 23 59	5986.7	6546.9	3.72

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
North Guilford Spire........	41 22 03.47	72 43 19.08	334 03 07	Hungry Hill..................	154 04 31	6721.7	7350.7	4.18
			10 28 24	Moose Hill..................	190 27 48	7004.9	7660.3	4.35
Branford Spire.............	41 16 18.24	72 49 46.34	244 02 17	Moose Hill..................	64 05 56	8602.8	9407.8	5.35
			328 05 26	Indian Neck	148 05 57	2065.2	2258.4	1.28
Falkner's Island Light-house.	41 12 40.78	72 38 54.02	245 54 23	Hammonasset................	65 58 43	10050.1	10990.5	6.24
			309 37 51	Horton's Point..............	129 46 00	22455.3	24556.4	13.95
South Milford..............	41 13 24.01	73 00 55.22	101 58 38	Tashua Hill.................	281 49 34	19652.6	21491.5	11.20
			205 22 17	Mount Carmel................	25 27 27	25458.3	27840.4	15.82
West Rock..................	41 19 54.03	72 57 22.35	71 49 37	Tashua Hill.................	251 38 11	25448.9	27830.1	15.81
			22 24 03	South Milford...............	202 21 41	13010.8	14228.2	8.08
Fort Wooster...............	41 16 53.32	72 53 14.89	269 34 49	Sachem's Head...............	89 41 28	14067.0	15383.2	8.74
			134 06 17	West Rock...................	314 03 34	8013.3	8763.1	4.98
East Rock..................	41 19 35.03	72 53 57.14	348 50 57	Fort Wooster................	168 51 25	5084.4	5560.2	3.16
			97 01 24	West Rock...................	276 59 08	4807.7	5257.6	2.99
Hemmingway.................	41 18 55.79	72 51 52.06	27 01 45	Fort Wooster................	207 00 50	4241.1	4637.9	2.63
			112 36 33	East Rock...................	292 35 10	3150.5	3445.3	1.96
Great Rock.................	41 20 29.16	72 50 50.98	26 42 08	Fort Wooster................	206 40 33	7452.2	8149.5	4.63
			68 55 20	East Rock...................	248 53 17	4639.2	5073.2	2.88
Mile Rock..................	41 16 45.80	72 51 27.38	125 08 38	West Rock...................	305 04 44	10094.7	11039.3	6.27
			64 50 32	South Milford...............	244 44 17	14613.0	15980.3	9.08
East Haven Spire...........	41 16 39.39	72 51 59.40	103 44 55	Fort Wooster................	283 44 05	1808.3	1977.5	1.12
			153 11 41	East Rock...................	333 10 23	6070.9	6639.0	3.77

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2

Name of station.	Latitude	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Morgan's Point	41 14 30.28	72 53 19.22	79 08 53	South Milford	259 03 52	10813.9	11825.7	6.72
			181 19 01	Fort Wooster	1 19 04	4412.8	4825.7	2.74
Dragon Spire	41 17 57.15	72 51 33.35	50 11 45	Fort Wooster	230 10 38	3075.4	3363.1	1.91
			166 28 23	Hemmingway	346 28 11	1860.4	2034.5	1.15
New Haven Light-house	41 14 54.01	72 53 54.85	74 12 21	South Milford	254 07 42	10175.4	11127.4	6.31
			152 28 02	West Rock	332 25 45	10438.1	11414.7	6.49
Jones	41 15 35.40	72 58 05.54	250 24 34	Fort Wooster	70 27 45	7178.1	7849.7	4.46
			187 10 19	West Rock	7 10 47	8041.0	8793.4	5.00
Jeremy North	41 16 11.10	72 55 42.91	71 39 24	Jones	251 37 50	3497.7	3824.9	2.17
			161 24 50	West Rock	341 23 44	7255.2	7934.1	4.51
Jeremy South	41 15 37.04	72 55 42.68	163 42 08	West Rock	343 41 02	8259.0	9031.8	5.13
			89 08 07	Jones	269 06 33	3325.0	3636.2	2.06
Pond Point	41 12 38.82	73 00 17.98	209 30 11	Jones	29 31 39	6259.2	6844.8	3.89
			221 21 21	Jeremy South	49 24 23	8444.9	9235.0	5.25
Oyster River Point	41 13 59.78	72 58 12.87	49 24 35	Pond Point	229 23 13	3837.5	4196.5	2.38
			73 45 08	South Milford	253 43 37	3940.1	4308.7	2.45
Allen	41 17 37.87	72 58 03.64	281 32 08	Fort Wooster	101 35 18	6857.1	7498.7	4.26
			0 40 02	Jones	180 40 01	3778.3	4131.8	2.35
Prindle	41 16 02.71	72 59 12.38	26 05 17	South Milford	206 04 09	5450.3	5960.2	3.39
			259 20 27	Fort Wooster	79 24 23	8463.0	9254.8	5.26
Fort Hale, or Mosquito Fort	41 16 10.90	72 54 00.99	66 11 48	Jeremy South	246 10 42	2587.0	2829.0	1.61
			145 46 42	West Rock	325 44 29	8325.4	9104.5	5.17

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Brewster's Factory Cupola, (New Haven.)	41 18 07.10	72 54 18.41	48 29 48	Jones	228 27 19	7058.9	7719.4	4.39
			127 39 01	West Rock	307 37 00	5401.8	5907.2	3.36
College Spire, (New Haven)	41 18 27.74	72 55 24.15	35 14 54	Jones	215 13 07	6509.0	7118.0	4.04
			134 05 03	West Rock	314 03 45	3826.2	4184.2	2.38
Episcopal Church, (New Haven.)	41 18 11.32	72 54 53.55	13 30 36	Jeremy South	193 30 03	4894.0	5351.9	3.04
			132 29 12	West Rock	312 27 33	4692.0	5131.0	2.91
West Haven Spire	41 16 15.27	72 56 42.73	57 27 52	Jones	237 26 58	2286.4	2500.3	1.42
			143 32 42	Allen	323 31 49	3168.3	3464.5	1.97
Benham's Chimney	41 15 05.46	72 58 34.48	216 07 22	Jones	36 07 42	1142.0	1248.9	0.71
			75 26 37	Gunn	255 22 38	8740.0	9557.8	5.43
North Milford Spire	41 16 39.82	73 01 15.20	291 48 26	Prindle	111 49 49	3079.0	3367.1	1.91
			222 05 35	West Rock	42 08 09	8076.0	8831.7	5.02
Hicock, (2)	41 23 10.04	72 59 53.26	329 51 58	West Rock	149 53 37	6989.8	7643.8	4.34
			4 33 15	South Milford	184 33 11	18133.9	19830.7	11.27
Hillhouse	41 19 38.22	72 59 28.30	260 31 57	West Rock	80 33 20	2969.0	3246.8	1.84
			174 55 37	Hicock, (2)	354 55 21	6559.4	7172.8	4.08
LONG ISLAND.								
Eastern part.								
Montauk Point	41 04 14.68	71 51 34.60	78 11 28	Montauk	258 09 54	3411.7	3731.0	2.12
			181 53 17	Watch Hill	1 53 44	26943.0	29464.0	16.74
Montauk Light-house	41 04 13.27	71 51 06.36	80 42 10	Montauk	260 40 17	4052.2	4431.4	2.52
			180 29 25	Watch Hill	0 29 32	26972.5	29495.8	16.76

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Fort Pond	41 01 43.57	71 58 39.39	127 25 48	Gardiner's Island	307 20 57	13189.8	14423.9	8.19
			238 18 42	Montauk	58 21 49	7548.3	8254.5	4.69
Napeague	41 00 21.28	72 01 17.14	147 49 22	Gardiner's Island	327 46 15	12464.3	13630.6	7.74
			236 32 05	Fort Pond	56 33 48	4603.4	5034.1	2.86
Napeague Beach	40 58 46.55	72 05 13.67	175 15 07	Gardiner's Island	355 14 35	13516.4	14781.1	8.40
			242 07 15	Napeague	62 09 50	6253.3	6838.4	3.88
Amagansett	40 59 16.13	72 07 54.31	191 49 36	Gardiner's Island	11 50 50	12800.4	13998.1	7.95
			257 45 02	Napeague	77 49 23	9497.5	10386.2	5.90
Accabonock	41 00 44.65	72 07 15.07	189 53 37	Gardiner's Island	9 54 25	9975.1	10908.5	6.20
			274 53 49	Napeague	94 57 43	8394.9	9180.4	5.21
Hog Creek Point	41 03 10.27	72 09 13.51	134 33 11	Brown's Hill	314 27 54	15781.5	17258.2	9.81
			219 59 32	Gardiner's Island	40 02 18	6966.0	7617.8	4.33
Cedar Point	41 02 37.07	72 13 44.63	157 50 01	Brown's Hill	337 47 43	13053.3	14274.7	8.11
			109 11 44	Shelter Island	289 06 45	11235.9	12287.2	6.98
Gardiner's Point	41 08 31.62	72 08 20.67	324 40 29	Gardiner's Island	144 42 00	5610.1	6135.0	3.49
			34 41 13	Cedar Point	214 37 39	13295.5	14539.6	8.26
Ram Head	41 04 43.04	72 16 25.39	171 50 00	Brown's Hill	351 49 27	8285.1	9060.3	5.15
			88 22 01	Shelter Island	268 18 20	6862.4	7504.5	4.26
Cleave's Point	41 06 52.60	72 19 59.75	308 36 19	Ram Read	128 38 40	6402.3	7001.4	3.98
			222 15 19	Brown's Hill	42 17 07	5681.9	6213.6	3.53
Hay Beach Point	41 06 17.06	72 19 38.55	212 06 24	Brown's Hill	32 07 58	6244.4	6828.7	3.88
			155 43 21	Cleave's Point	335 43 08	1202.7	1315.2	0.75

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United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Long Beach	41 07 04.45	72 17 05.14	176 15 39	Brown's Hill	356 15 32	3847.3	4207.3	2.39
			84 53 28	Cleave's Point	264 51 33	4090.2	4472.9	2.54
Oyster Pond	41 09 30.88	72 13 48.46	131 55 05	Cornfield Point	311 48 35	17055.9	18651.8	10.60
			82 02 25	Brown's Hill	262 00 09	4882.9	5339.8	3.03
Conkling	41 06 14.22	72 22 54.87	235 41 38	Brown's Hill	55 45 21	9568.1	10463.4	5.95
			180 04 50	Cornfield Point	0 04 50	17449.4	19082.1	10.84
Rocky Point	41 08 13.53	72 20 53.34	251 21 34	Brown's Hill	71 23 57	5350.2	5850.8	3.32
			168 29 50	Cornfield Point	348 27 59	14052.4	15367.3	8.73
Southold Spire	41 03 44.09	72 25 31.33	229 02 12	Brown's Hill	49 07 38	15297.4	16728.8	9.50
			146 54 15	Horton's Point	326 53 02	2642.3	2889.5	1.64
Hog Neck	41 01 22.10	72 19 16.77	122 56 26	Horton's Point	302 51 45	12135.2	13270.7	7.54
			154 31 40	Shelter Island	334 30 20	6645.5	7267.3	4.13
Smith's Farm	41 00 00.10	72 16 00.72	138 56 01	Shelter Island	318 52 37	11316.8	12375.7	7.03
			118 55 33	Hog Neck	298 53 24	5232.7	5722.3	3.25
Cedar Island	41 02 23.74	72 15 18.24	71 10 55	Hog Neck	251 08 18	5886.9	6437.7	3.66
			12 37 46	Smith's Farm	192 37 17	4540.3	4965.1	2.82
Cedar Island Light-house	41 02 25.61	72 15 18.92	12 16 37	Smith's Farm	192 16 10	4593.0	5022.8	2.85
			70 35 58	Hog Neck	250 33 22	5891.0	6442.2	3.66
Sag Harbor Spire	40 59 53.23	72 17 20.73	135 19 42	Hog Neck	315 18 26	3855.7	4216.5	2.40
			263 31 28	Smith's Farm	83 32 21	1881.8	2057.9	1.17
Flanders	40 54 03.44	72 36 22.80	195 35 42	Mattituck Hills	15 37 10	11612.1	12698.7	7.21
			128 17 19	Friar's Head	308 12 45	12455.4	13620.9	7.74

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Southport	40 54 49.90	72 33 22.39	173 35 54	Mattituck Hills	353 35 23	9812.4	10730.6	6.10
			71 16 10	Flanders	251 14 12	4458.3	4875.5	2.77
Holmes' Hill	40 56 48.05	72 25 03.52	115 37 48	Mattituck Hills	295 31 50	14143.3	15466.7	8.79
			72 42 10	Southport	252 36 43	12226.0	13370.0	7.60
Noyack	40 59 22.43	72 21 56.55	94 33 33	Mattituck Hills	274 25 28	17174.9	18782.0	10.67
			42 34 07	Holmes' Hill	222 32 04	6463.9	7068.7	4.02
Great Hog Neck	41 01 45.02	72 23 19.30	336 15 49	Noyack	156 16 43	4804.3	5253.8	2.99
			277 05 12	Hog Neck	97 07 43	5711.1	6245.5	3.55
Jessup's Neck	41 00 49.18	72 22 11.06	352 46 47	Noyack	172 46 57	2697.3	2949.7	1.68
			255 59 15	Hog Neck	76 01 06	4198.4	4591.3	2.61
Reeves	40 58 56.35	72 30 34.09	27 23 27	Southport	207 21 24	8559.9	9360.9	5.32
			297 05 00	Holmes' Hill	117 08 37	8683.6	9496.1	5.40
Little Hog Neck	40 59 25.32	72 25 55.77	82 12 24	Reeves	262 09 22	6566.5	7180.9	4.08
			345 51 39	Holmes' Hill	165 52 13	5002.2	5470.3	3.11
Robbin's Island	40 57 47.34	72 27 26.28	298 41 56	Holmes' Hill	118 43 30	3806.9	4163.1	2.37
			249 08 25	Noyack	69 11 57	8247.6	9019.3	5.13
Mattituck, (flag-staff)	40 59 25.24	72 31 44.65	15 04 18	Southport	195 03 14	8795.0	9618.0	5.47
			298 23 17	Reeves	118 24 07	1874.7	2050.1	1.67
Shinnecock	40 53 00.46	72 27 52.57	209 23 03	Holmes' Hill	29 24 54	8057.8	8811.8	5.01
			146 10 15	Mattituck Hills	326 06 08	15808.7	17287.9	9.82
Manor	41 01 36.72	72 31 44.81	50 20 50	Mattituck Hills	230 19 15	4382.3	4792.4	2.72
			341 08 59	Shinnecock	161 11 23	16824.8	18399.1	10.45

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Brown's Point	40 56 50.89	72 33 10.35	270 23 50	Holmes' Hill	90 29 02	11386.2	12451.6	7.07
			313 40 47	Shinnecock	133 44 15	10286.2	11248.7	6.39
Upper Aquebogue	40 56 45.31	72 36 58.32	305 09 22	Southport	125 11 35	6180.0	6758.3	3.84
			350 32 47	Flanders	170 33 10	5061.6	5535.2	3.15
Indian Island	40 55 34.08	72 36 34.26	286 51 47	Southport	106 53 45	4691.5	5130.5	2.92
			354 30 53	Flanders	174 31 01	2867.9	3070.6	1.75
James Port Spire	40 56 17.70	72 34 22.77	332 26 57	Southport	152 27 28	3054.8	3340.6	1.90
			34 09 12	Flanders	214 07 54	5003.6	5471.8	3.11
Osborn Hill	40 52 46.43	72 42 17.90	171 41 07	Friar's Head	351 40 25	10193.2	11147.0	6.33
			220 05 14	Mattituck Hills	40 10 34	17733.8	19393.2	11.02
Riverhead Court-house	40 54 59.24	72 39 25.95	137 28 44	Friar's Head	317 26 10	8129.1	8889.7	5.05
			44 30 24	Osborn Hill	224 28 32	5742.4	6279.7	3.57
Luce's Landing	40 58 40.68	72 37 26.41	307 58 05	Shinnecock	128 04 12	17038.8	18633.1	10.59
			31 59 46	Osborn Hill	211 56 29	12879.9	14085.1	8.00
Franklinville	40 57 49.84	72 33 38.14	170 11 59	Mattituck Hills	350 11 39	4263.2	4662.1	2.65
			52 27 56	Osborn Hill	232 22 15	15344.4	16780.2	9.53
Old Landing	40 58 40.94	72 40 34.52	12 29 07	Osborn Hill	192 27 53	11199.7	12247.7	6.96
			77 42 45	Friar's Head	257 40 56	3982.7	4355.4	2.48
Good Ground	40 52 18.17	72 33 50.24	261 07 09	Shinnecock	81 11 03	8474.0	9266.9	5.27
			178 14 27	Mattituck Hills	358 14 12	14437.2	15788.1	8.97
Inlet West	40 49 41.46	72 31 05 55	216 20 57	Shinnecock	36 23 03	7621.8	8335.0	4.74
			141 25 38	Good Ground	321 23 50	6184.2	6762.9	3.84

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Inlet East	40 50 45.87	72 27 16.37	69 43 08	Inlet West	249 40 36	5724.3	6259.9	3.56
			168 27 43	Shinnecock	348 27 19	4236.8	4633.2	2.63
Cormorant Point	40 51 51.99	72 29 20.77	304 58 59	Inlet East	125 00 21	3556.2	3889.0	2.21
			224 20 56	Shinnecock	44 21 55	2953.5	3233.9	1.84
Ram Pasture	40 51 08.28	72 31 20.78	45 29 28	Quogue	225 27 13	6793.5	7429.2	4.22
			352 25 04	Inlet West	172 25 12	2702.3	2955.2	1.68
South Hampton	40 51 48.19	72 23 56.08	111 56 51	Shinnecock	291 54 16	5969.2	6527.7	3.71
			67 44 11	Inlet East	247 41 59	5069.7	5544.1	3.15
Great Hill	40 55 08.51	72 23 08.23	10 16 36	South Hampton	190 16 06	6279.3	6866.9	3.90
			59 20 07	Shinnecock	239 17 01	7738.6	8462.7	4.81
Bridge Hampton	40 53 46.39	72 18 33.10	64 17 17	South Hampton	244 13 44	8394.1	9179.5	5.22
			111 30 06	Great Hill	291 27 06	6918.8	7566.2	4.40
Drake's Hill	40 57 54.00	72 18 58.35	48 53 17	Great Hill	228 50 33	7759.6	8485.7	4.82
			355 34 22	Bridge Hampton	175 34 43	7660.4	8377.2	4.76
South Hampton Spire	40 53 01.16	72 23 02.28	257 29 33	Bridge Hampton	77 32 27	6454.2	7058.1	4.01
			212 15 57	Drake's Hill	32 18 30	10684.7	11684.5	6.64
Sag Beach	40 55 08.05	72 15 03.73	62 48 49	Bridge Hampton	242 46 36	5508.9	6024.4	3.42
			133 01 48	Drake's Hill	312 59 14	7504.7	8206.9	4.66
Barnes' Island	40 57 11.82	72 11 52.49	97 28 58	Drake's Hill	277 24 18	10042.7	10982.4	6.24
			49 32 13	Sag Beach	229 30 08	5881.0	6431.3	3.66
East Hampton Spire	40 57 27.08	72 11 05.78	56 59 44	Bridge Hampton	236 54 55	12483.5	13631.6	7.76
			94 20 26	Drake's Hill	274 15 16	11080.6	12117.4	6.88

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Long Island, south side.								
Terry	40 51 03.02	72 45 43.82	50 02 16	Base East	229 51 00	31738.5	34708.3	19.72
			88 12 19	Ruland's Hill	268 01 55	22360.5	24452.8	13.89
Ketchabonock	40 47 34.18	72 39 25.40	150 31 16	Osborn Hill	330 28 51	11065.3	12100.1	6.87
			122 07 17	Terry	302 02 37	12126.7	13261.4	7.53
Quogue	40 48 33.83	72 34 47.50	126 28 59	Osborn Hill	306 24 06	13115.2	14342.4	8.15
			70 12 12	Ketchabonock	250 09 47	5427.6	5935.5	3.37
Foster	40 48 50.92	72 35 59.19	55 22 29	Ketchabonock	235 20 35	4164.1	4553.7	2.59
			287 25 03	Quogue	107 25 50	1760.7	1925.5	1.09
Moriches	40 46 17.41	72 43 07.49	185 31 30	Osborn Hill	5 32 05	12055.5	13183.5	7.49
			157 25 54	Terry	337 24 12	9541.0	10433.8	5.93
Speonk	40 47 45.67	72 41 29.73	274 39 10	Ketchabonock	94 41 35	4336.1	4741.8	2.69
			40 06 48	Moriches	220 05 33	3559.3	3892.4	2.21
Oliver	40 46 58.24	72 44 51.79	297 13 55	Moriches	117 14 50	2750.1	2927.4	1.71
			252 49 03	Speonk	72 51 15	4957.8	5421.7	3.08
Floyd	40 45 29.92	72 48 41.47	243 08 47	Oliver	63 11 29	6035.5	6600.3	3.75
			202 02 30	Terry	22 04 26	11085.8	12123.1	6.89
Head and Horns	40 39 49.23	73 03 39.47	73 17 23	Base West	253 11 36	13059.0	14280.9	8.11
			188 04 40	Ruland's Hill	8 05 59	20249.3	22144.0	12.58
Watch Hill	40 41 26.98	72 58 52.83	65 53 46	Head and Horns	245 50 39	7375.4	8065.5	4.58
			167 12 14	Ruland's Hill	347 10 26	17457.6	19102.0	10.85

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Belleville Beach	40 42 43.67	72 55 27.35	149 23 14	Ruland's Hill	329 19 12	17048.0	18643.2	10.59
			63 53 45	Watch Hill	243 51 29	5372.0	5874.7	3.34
Blue Point	40 43 42.09	73 01 44.21	20 39 12	Head and Horns	200 37 57	7675.0	8393.2	4.77
			315 59 44	Watch Hill	136 01 36	5791.8	6333.7	3.60
Patchogue	40 44 48.25	72 59 50.03	52 42 36	Blue Point	232 41 22	3367.6	3682.7	2.09
			347 47 37	Watch Hill	167 48 14	6351.3	6945.6	3.95
Howell's Point	40 44 23.04	72 56 24.92	80 27 29	Blue Point	260 24 00	7597.0	8307.9	4.72
			32 36 08	Watch Hill	212 34 32	6444.9	7047.9	4.01
Ketchum	40 45 22.81	72 54 10.17	59 45 43	Howell's Point	239 44 15	3659.0	4001.4	2.27
			20 15 29	Belleville Beach	200 14 39	5231.6	5721.1	3.25
Smith's Point	40 44 24.51	72 52 33.52	52 41 24	Belleville Beach	232 39 31	5129.8	5609.8	3.19
			128 25 11	Ketchum	308 24 08	2893.7	3164.5	1.80
Smith's Beach	40 44 07.47	72 50 56.40	67 54 03	Belleville Beach	247 51 06	6863.8	7506.1	4.27
			93 35 41	Howell's Point	273 32 07	7722.6	8445.2	4.80
Wm. Smith	40 45 18.63	72 52 33.48	40 29 50	Belleville Beach	220 27 57	6283.6	6871.6	3.91
			93 15 27	Ketchum	273 14 24	2271.4	2483.9	1.41
Belleport Spire	40 45 18.08	72 56 03.91	349 47 13	Belleville Beach	169 47 37	4839.0	5291.8	3.01
			288 29 21	Smith's Point	108 31 38	5204.5	5691.5	3.23
Charles Osborn	40 45 40.01	72 55 40.27	356 48 40	Belleville Beach	176 48 48	5447.4	5957.1	3.39
			297 58 43	Smith's Point	118 00 45	4960.9	5425.1	3.08
Brown's Point	40 43 23.37	73 03 47.03	358 27 39	Head and Horns	178 27 44	6607.0	7225.2	4.11
			258 39 26	Blue Point	78 40 46	2939.2	3214.2	1.83

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Green's Point	40 43 01.13	73 06 03.45	257 53 55	Brown's Point	77 55 24	3273.9	3580.2	2.94
			339 15 28	Head and Horns	150 17 02	6816.1	7453.9	4.24
Nicoll's Point	40 41 52.23	73 08 36.58	239 23 21	Green's Point	59 25 01	4175.5	4655.7	2.64
			298 30 39	Head and Horns	118 33 53	7941.0	8684.0	4.93
Morris	40 43 45.04	73 06 52.06	35 11 31	Nicoll's Point	215 10 27	4257.3	4655.7	2.64
			319 53 27	Green's Point	139 53 59	1770.6	1936.3	1.10
Seaman	40 43 15.18	73 08 39.28	276 44 31	Green's Point	96 46 13	3682.8	4037.4	2.29
			249 53 08	Morris	69 54 17	2679.6	2930.3	1.67
Jones	40 38 42.79	73 09 13.10	188 20 47	Nicoll's Point	8 21 11	5905.3	6457.9	3.67
			209 10 55	Green's Point	29 12 59	9127.9	9982.0	5.67
Baberry Island	40 42 18.43	73 12 31.52	324 58 01	Jones	145 00 10	8120.7	8880.6	5.05
			278 18 53	Nicoll's Point	98 21 26	5573.8	6095.4	3.47
Conklin's Point	40 41 02.43	73 16 23.89	246 43 31	Baberry Island	66 46 03	5937.2	6492.7	3.69
			317 49 32	Base West	97 51 43	8124.8	8885.0	5.05
Cumpaum	40 42 19.84	73 15 05.93	270 40 39	Baberry Island	90 42 20	3624.5	3963.6	2.25
			37 28 32	Conklin's Point	217 27 41	3008.4	3289.9	1.87
Thurber's Neck	40 43 10.38	73 13 51.28	310 33 35	Baberry Island	130 34 27	2464.1	2694.7	1.53
			48 20 47	Cumpaum	228 19 58	2345.0	2564.4	1.46
Fire Island Light-house	40 37 53.17	73 12 50.67	139 31 04	West Hills	319 23 00	26767.4	29272.0	16.63
			213 40 44	Ruland's Hill	33 48 03	28412.9	31071.5	17.66
Oak Island Inlet	40 38 12.77	73 16 36.13	183 08 43	Conklin's Point	3 08 51	5240.3	5730.6	3.26
			277 49 03	Base West	97 51 43	5796.3	6338.7	3.61

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Sampawam's Creek	40 40 47.63	73 18 34.71	261 32 19	Conklin's Point	81 33 44	3105.2	3395.8	1.93
			329 44 34	Oak Island Inlet	149 45 51	5528.8	6046.1	3.44
Fleet's Point	40 40 03.31	73 20 39.33	244 57 13	Sampawam's Creek	64 58 34	3229.9	3532.1	2.01
			300 48 22	Oak Island Inlet	120 51 00	6652.7	7275.2	4.13
Oak Island Beach	40 37 33.00	73 20 25.80	257 10 21	Oak Island Inlet	77 12 51	5534.2	6052.0	3.44
			176 04 43	Fleet's Point	356 04 35	4646.9	5081.7	2.89
Oak Island	40 38 26.84	73 17 36.50	162 31 37	Sampawam's Creek	342 30 59	4552.5	4978.5	2.83
			124 43 51	Fleet's Point	304 41 52	5224.8	5713.7	3.25
Cedar Island	40 38 59.73	73 20 18.46	216 12 06	Sampawam's Creek	36 13 14	4124.8	4510.8	2.56
			165 58 08	Fleet's Point	345 57 54	2021.5	2210.7	1.26
Babylon	40 41 31.44	73 18 57.66	338 15 20	Sampawam's Creek	158 15 35	1454.5	1590.6	0.90
			283 54 26	Conklin's Point	103 56 06	3719.3	4067.3	2.31
Munsey	40 40 46.38	73 20 54.29	269 18 41	Sampawam's Creek	89 20 12	3277.8	3584.5	2.04
			345 10 55	Fleet's Point	165 11 05	1373.8	1502.4	0.85
Half Neck	40 39 20.64	73 23 16.16	250 19 30	Fleet's Point	70 21 12	3911.4	4277.4	2.43
			309 39 39	Oak Island Beach	129 41 30	5200.2	5686.8	3.23
Gilgo Inlet	40 36 43.52	73 23 36.82	251 12 40	Oak Island Beach	71 14 44	4741.5	5185.2	2.95
			185 43 11	Half Neck	5 43 25	4870.1	5325.8	3.03
Uncaway	40 38 58.40	73 25 31.60	327 02 01	Gilgo Inlet	147 03 15	4957.5	5421.4	3.08
			257 49 04	Half Neck	77 50 32	3254.5	3559.0	2.02
High Hill	40 36 10.72	73 28 16.48	261 13 33	Gilgo Inlet	81 16 35	6650.9	7273.2	4.13
			216 49 38	Uncaway	36 51 25	6461.9	7066.5	4.02

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Jones' Beach East	40 36 46.87	73 25 02.52	76 16 28	High Hill	256 14 22	4693.6	5112.8	2.92
			170 26 28	Uncaway	350 26 09	4113.5	4498.4	2.56
Brick-house Point	40 39 12.32	73 27 26.12	11 56 07	High Hill	191 55 35	5724.3	6259.8	3.56
			279 03 23	Uncaway	99 04 38	2724.2	2979.1	1.69
Little Neck	40 39 20.90	73 31 06.71	325 41 31	High Hill	145 43 21	7099.4	7763.7	4.41
			272 54 11	Brick-house Point	92 56 35	5188.1	5673.6	3.22
New Inlet	40 35 51.76	73 32 54.24	264 51 20	High Hill	84 54 21	6555.8	7169.2	4.07
			201 23 01	Little Neck	21 24 11	6927.6	7575.8	4.30
Lines' Island	40 37 58.02	73 28 18.49	208 13 24	Brick-house Point	28 14 03	2601.1	2844.5	1.62
			122 54 57	Little Neck	302 52 54	4706.6	5147.0	2.92
Jones' Beach West	40 35 37.92	73 30 09.92	249 12 51	High Hill	69 14 05	2851.4	3118.2	1.77
			169 01 27	Little Neck	349 00 50	7005.3	7660.8	4.35
Great Island	40 37 36.46	73 30 10.93	232 37 13	Brick-house Point	52 39 00	4872.0	5327.9	3.03
			157 52 17	Little Neck	337 51 41	3477.6	3803.0	2.16
Raynor	40 38 22.96	73 34 04.49	340 29 54	New Inlet	160 30 40	4947.0	5409.9	3.07
			246 49 13	Little Neck	66 51 09	4542.6	4967.7	2.82
Titus	40 37 11.81	73 37 41.44	290 03 48	New Inlet	110 06 55	7188.1	7860.7	4.47
			246 41 28	Raynor	66 43 50	5550.2	6069.5	3.45
Long Beach East	40 35 18.91	73 34 28.48	245 24 56	New Inlet	65 25 59	2436.4	2664.4	1.52
			185 40 19	Raynor	5 40 34	5704.6	6238.4	3.55
Blue Hole	40 36 53.49	73 34 27.00	97 04 10	Titus	277 02 03	4604.7	5035.6	2.87
			190 50 54	Raynor	10 51 09	2809.9	3072.8	1.75

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Long Beach	40 35 08.02	73 36 33.95	255 20 36	New Inlet	75 22 59	5339.0	5838.6	3.32
			210 17 01	Raynor	30 18 38	6963.6	7615.2	4.33
Gentleman's Hill	40 34 59.79	73 39 05.36	205 50 41	Titus	25 51 36	4524.4	4947.8	2.81
			259 33 33	New Inlet	79 37 34	8871.8	9701.9	5.48
Near Rockaway	40 38 00.53	73 39 29.03	300 42 47	Titus	120 43 57	2941.2	3216.4	1.83
			354 17 54	Gentleman's Hill	174 18 10	5602.0	6126.2	3.48
Hog Island	40 36 18.96	73 39 09.54	231 47 09	Titus	51 48 06	2635.4	2882.0	1.64
			171 41 04	Near Rockaway	351 40 51	3165.9	3462.1	1.97
Pavilion	40 35 44.72	73 44 55.54	279 31 05	Gentleman's Hill	99 34 53	8348.6	9129.8	5.19
			241 20 20	Near Rockaway	61 23 53	8742.6	9560.7	5.43
Hicks' Neck	40 36 51.49	73 42 28.82	305 44 36	Gentleman's Hill	125 46 49	5894.1	6445.6	3.66
			243 13 52	Near Rockaway	63 15 49	4731.2	5173.9	2.94
Hicks' Beach	40 35 33.46	73 42 31.78	282 03 23	Gentleman's Hill	102 05 37	4963.3	5427.7	3.08
			223 25 20	Near Rockaway	43 27 19	6247.1	6831.6	3.88
Howard, (Staten Island)	40 37 36.73	74 05 03.89	163 34 41	Weasel	343 30 54	28862.7	31563.4	17.93
			243 19 10	Harrow	63 36 48	42542.3	46543.2	26.43
Mount Prospect	40 40 15.73	73 57 41.40	140 54 53	Weasel	320 46 16	29373.5	32122.0	18.25
			64 47 02	Howard	244 42 14	11493.6	12569.1	7.14
Flatlands	40 36 57.10	73 55 13.25	95 05 08	Howard	274 58 43	13934.9	15238.8	8.66
			150 24 33	Mount Prospect	330 22 58	7046.1	7705.4	4.38
Coney Island East	40 34 30.78	73 55 56.16	114 03 33	Howard	293 57 34	14096.0	15415.0	8.76
			192 36 01	Flatlands	12 36 24	4624.3	5057.0	2.87

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Wyckoff	40 34 27.95	73 58 00.25	182 21 46	Mount Prospect	2 21 56	10735.6	11958.9	6.67
			120 21 01	Howard	300 16 25	11536.6	12616.1	7.17
Rockaway Beach	40 34 49.13	73 49 36.69	131 31 52	Mount Prospect	311 26 37	15206.5	16629.4	9.45
			86 53 19	Wyckoff	266 47 53	11860.2	12969.9	7.37
Barren Island	40 34 26.28	73 52 58.33	148 20 30	Mount Prospect	328 17 26	12665.8	13850.9	7.87
			90 26 37	Wyckoff	270 23 23	7100.6	7765.0	4.41
Canausey	40 37 44.69	73 52 59.46	64 58 46	Flatlands	244 57 17	3470.0	3794.7	2.16
			318 37 24	Rockaway Beach	138 39 36	7214.0	7889.0	4.48
Jamaica South	40 39 24.87	73 47 17.73	21 01 08	Rockaway Beach	200 59 37	9110.0	9962.4	5.66
			68 58 42	Canausey	248 54 59	8603.1	9408.1	5.35
Booraem	40 39 54.27	73 49 35.86	50 07 59	Canausey	230 05 36	6233.2	6816.4	3.87
			0 07 05	Rockaway Beach	180 07 04	9412.2	10292.9	8.09
New Lots, (spire)	40 39 50.44	73 52 51.00	304 06 13	Pavilion	124 11 24	1350.3	1476.7	0.84
			333 48 48	Rockaway Beach	153 50 55	10355.6	11324.7	6.43
Long Island, north side.								
Glover	40 57 36.23	72 49 17.60	53 28 47	Ruland's Hill	233 20 42	21581.1	23600.4	13.41
			337 24 20	Terry	157 36 40	13120.1	14347.8	8.15
Fresh Pond	40 57 44.25	72 46 37.11	358 52 45	Friar's Head	78 54 54	4673.2	500.5	2.90
			326 32 43	Osborn	146 35 34	11006.9	12036.8	6.84
Hallock	40 57 10.90	72 55 11.85	36 48 58	Ruland's Hill	216 45 43	15089.8	16501.8	9.38
			310 25 27	Terry	130 32 35	17478.2	19113.6	10.86

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Woodhull	40 57 18.26	72 53 12.22	85 24 17	Hallock	265 22 04	2806.7	3069.3	1.74
			317 46 01	Terry	137 50 56	15622.3	17084.1	9.71
Mount Sinai	40 56 38.90	73 01 52.42	358 15 19	Ruland's Hill	178 15 29	11100.5	12159.2	6.90
			294 28 36	Terry	114 39 03	24925.3	27257.6	15.49
Mount Pleasant	40 48 52.09	73 10 13.81	254 39 43	Ruland's Hill	74 45 21	12528.3	13700.6	7.78
			328 05 44	Base East	148 10 19	19293.7	21099.0	11.99
Little	40 52 57.49	73 12 53.02	285 02 16	Ruland's Hill	105 09 38	16371.8	17903.7	10.17
			333 45 27	Mount Pleasant	153 47 12	8437.4	9226.9	5.24
Blydenburgh	40 53 06.95	73 11 01.28	351 56 48	Mount Pleasant	171 57 22	7939.0	8691.9	4.93
			83 38 18	Little	263 37 07	2632.2	2878.5	1.64
Stony Brook	40 53 22.44	73 10 16.59	292 28 18	Ruland's Hill	112 33 58	13145.1	14375.1	8.17
			359 33 13	Mount Pleasant	179 33 14	8338.6	9118.9	5.18
Smithtown	40 54 17.75	73 14 28.92	329 14 08	Mount Pleasant	149 16 54	11686.1	12779.6	7.26
			286 05 31	Stony Brook	106 08 16	6147.1	6722.3	3.82
Ketchum	40 53 04.16	73 17 29.72	307 14 59	Mount Pleasant	127 19 44	12832.6	14033.4	7.97
			269 25 15	Blydenburgh	89 29 26	9093.6	9944.5	5.65
Carl	40 48 54.49	73 17 55.30	231 12 13	Blydenburgh	51 16 35	12436.7	13600.4	7.73
			184 27 16	Ketchum	4 27 27	7723.2	8445.9	4.80
Crane Neck	40 57 52.88	73 08 57.39	12 31 48	Stony Brook	192 39 56	8544.5	9344.0	5.31
			49 28 46	Smithtown	229 25 09	10205.8	11160.2	6.34
Broken Land	40 55 24.02	73 17 52.03	289 20 24	Stony Brook	109 25 26	11299.1	12355.4	7.02
			249 47 19	Crane Neck	69 53 13	13320.1	14566.5	8.28

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Nassekeag	40 54 31.68	73 05 21.28	323 53 09	Ruland's Hill	143 55 35	8873.5	9703.8	5.52
			33 12 43	Mount Pleasant	213 09 31	12515.4	13686.5	7.78
Cumsewang	40 56 06.81	73 03 28.19	35 20 50	Mount Pleasant	215 16 25	16430.3	17967.7	10 21
			345 40 12	Ruland's Hill	165 41 24	10427.8	11403.5	6 48
Mooney Ponds	40 49 55.45	73 04 58.58	253 57 11	Ruland's Hill	73 59 22	4889.0	5346.8	3.04
			176 26 01	Nassekeag	356 25 46	8536.8	9335.6	8.10
Mount Misery	40 57 41.23	73 03 38.68	155 03 14	Tashua Hill	334 55 59	36560.8	39981.8	22.72
			267 53 32	Friar's Head	88 06 51	28487.6	31153.2	17.70
Miller's Place	40 57 55.81	72 59 33.40	147 08 23	Tashua Hill	326 58 26	38944.8	42588.9	24.20
			85 31 17	Mount Misery	265 28 36	5754.2	6292.6	3.58
Old Field Point	40 58 33.66	73 06 47.60	67 29 40	Crane Neck	247 28 15	3284.8	3592.2	2.04
			344 51 26	Nassekeag	164 52 34	7731.3	8454.7	4.80
Andrew Miller	40 57 35.74	73 05 43.76	140 07 42	Old Field	320 07 00	2328.9	2546.8	1.45
			96 40 38	Crane Neck	276 38 31	4558.3	4984.8	2.83
Setauket Episcopal church, (spire.)	40 56 45.48	73 06 25.63	120 22 25	Crane Neck	300 20 46	4112.7	4497.5	2.56
			212 16 51	Andrew Miller	32 17 19	1833.5	2005.1	1.14
Setauket Presbyterian church, (spire.)	40 56 43.04	73 06 20.85	120 29 13	Crane Neck	300 27 30	4247.3	2644.7	2.64
			208 05 16	Andrew Miller	28 05 40	1842.3	2014.7	1.14
Old Field Point Light-house	40 58 34.45	73 06 47.83	320 24 18	Andrew Miller	140 25 00	2351.0	2571.0	1.46
			67 03 14	Crane Neck	247 01 49	3289.5	3597.3	2.04
Stony Brook Bank	40 55 17.25	73 08 32.64	34 29 30	Stony Brook	214 28 20	4296.5	4698.5	2.67
			90 57 45	Broken Land	270 51 33	13089.6	14314.4	8.13

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Nissequague	40 55 04.58	73 10 37.85	351 02 10	Stony Brook	171 02 19	3189.8	3488.3	1.98
			262 23 21	Stony Brook Bank	82 24 40	2954.8	3231.3	1.84
East Blydenburgh	40 51 14.52	73 12 19.62	207 52 22	Blydenburgh	27 53 10	3923.1	4290.2	2.44
			326 07 52	Mount Pleasant	146 09 14	5290.1	5785.1	3.29
Buffet	40 53 17.48	73 16 39.37	272 19 05	Blydenburgh	92 22 43	7920.8	8662.0	4.92
			312 09 25	Mount Pleasant	132 13 37	12187.7	14128.1	7.57
Dix Hill	40 48 57.07	73 20 39.32	88 47 16	West Hills	268 44 18	6396.8	6995.4	3.97
			330 58 57	Base West	151 04 12	23619.2	25829.2	14.68
Huntington	40 51 07.16	73 25 04.71	2 25 32	West Hills	182 25 27	4153.9	4542.6	2.58
			302 48 36	Dix Hill	122 51 31	7399.4	8091.8	4.60
Long Hill	40 52 55.84	73 20 05.63	6 06 43	Dix Hill	186 06 22	7405.9	8098.9	4.60
			64 26 52	Huntington	244 23 37	7763.0	8489.4	4.82
Eaton	40 56 18.77	73 23 13.07	324 57 58	Long Hill	145 00 01	7643.0	8358.2	4.75
			15 13 00	Huntington	195 11 47	9960.0	10892.0	6.19
Sheep	40 51 00.91	73 30 17.89	153 57 37	Round Hill	333 51 11	31245.7	34169.4	19.41
			61 58 45	Harrow	241 53 41	12327.6	13481.1	7.66
Mill Neck	40 52 57.59	73 33 06.20	36 26 37	Harrow	216 23 23	11678.7	12771.5	7.26
			312 23 09	Sheep	132 24 59	5336.8	5836.2	3.32
Cooper's Bluff	40 53 37.05	73 29 31.04	76 25 55	Mill Neck	256 23 35	5181.3	5666.1	3.22
			12 50 14	Sheep	192 49 38	4939.3	5401.7	3.07
East Fort	40 55 43.46	73 25 29.96	251 12 22	Eaton	71 13 51	3381.8	3698.2	2.10
			304 14 06	Long Hill	124 17 52	9183.0	10042.3	5.71

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Little Neck Point	40 54 46.17	73 22 11.09	153 05 21	Eaton	333 04 40	3202.7	3502.4	1.99
			110 48 54	East Fort	290 46 44	4976.5	5442.2	3.09
Crab Meadow	40 55 27.72	73 20 36.11	113 13 31	Eaton	293 11 48	3994.5	4368.3	2.48
			60 02 06	Little Neck Point	240 01 04	2364.9	2586.2	1.47
East Neck	40 54 15.81	73 25 25.56	219 14 51	Eaton	39 16 18	4896.8	5355.0	3.04
			258 21 34	Little Neck Point	78 23 42	4644.9	5079.5	2.89
Gallows Hill	40 52 58.41	73 23 29.42	69 17 01	Sheep	249 12 38	10227.9	11184.9	6.35
			183 32 17	Eaton	3 32 28	6191.8	6771.2	3.85
Huntington Harbor	40 53 36.72	73 24 43.10	202 50 38	Eaton	22 51 37	5423.6	5931.1	3.37
			304 24 34	Gallows Hill	124 25 32	2091.1	2286.8	1.30
Van Wyck	40 53 33.90	73 26 13.59	219 41 57	Eaton	39 43 46	6609.9	7228.4	4.11
			285 53 38	Gallows Hill	105 55 25	3990.9	4364.3	2.48
Crossman	40 54 22.76	73 28 21.16	243 34 16	Eaton	63 37 38	8046.9	8799.9	5.00
			290 49 53	Gallows Hill	110 53 04	7307.2	7990.9	4.54
Huntington Spire	40 52 25.42	73 24 52.24	185 32 38	Huntington Harbor	5 32 43	2209.7	2416.5	1.37
			242 18 13	Gallows Hill	62 19 07	2189.5	2394.3	1.36
Northport	40 54 19.10	73 20 43.30	45 58 18	Huntington	225 55 27	8514.8	9311.5	5.29
			136 30 05	Eaton	316 28 27	5089.5	5565.7	3.16
Centreport	40 53 10.54	73 21 55.18	162 34 37	Eaton	342 33 46	6084.8	6654.2	3.78
			218 30 09	North Point	38 30 56	2702.1	2954.9	1.68
Eaton's Point Light-house	40 57 11.86	73 23 25.06	350 17 09	Eaton	170 17 17	1661.5	1817.0	1.03
			46 58 59	East Fort	226 57 38	3995.8	4369.7	2.48

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
17 Allen	40 53 59.86	73 32 39.48	328 59 53	Sheep	149 01 26	6438.4	7040.8	4.00
			279 02 50	Cooper's Bluff	99 04 53	4466.2	4884.1	2.78
Ludlum	40 54 56.23	73 31 09.93	350 28 02	Sheep	170 28 36	7360.0	8048.7	4.57
			284 37 57	Crossman	104 39 48	4082.1	4464.1	2.54
Oyster Bay	40 53 00.85	73 32 43.12	317 23 52	Sheep	137 25 27	5024.8	5495.0	3.12
			256 02 13	Cooper's Bluff	76 04 19	4632.6	5066.1	2.88
Northwest Bluff	40 55 34 83	73 29 23.48	2 47 15	Cooper's Bluff	182 47 10	3637.3	3977.6	2.26
			44 32 46	Oyster Bay	224 30 35	6662.0	7285.4	4.14
Lloyd's Neck	40 56 20.32	73 28 01.64	270 22 51	Eaton	90 26 00	6749.6	7381.2	4.19
			17 56 49	Sheep	197 55 20	10355.5	11324.5	6.43
Centre Island	40 53 14.45	73 31 10.72	343 16 45	Sheep	163 17 20	4300.7	4703.1	2.67
			253 21 41	Cooper's Bluff	73 22 46	2435.1	2662.9	1.51
Jones	40 51 36.55	73 28 16.81	68 49 05	Sheep	248 47 40	3041.4	3326.0	1.89
			154 56 48	Cooper's Bluff	334 55 59	4102.6	4486.5	2.55
Cold Spring	40 52 14.15	73 27 28.84	131 48 06	Cooper's Bluff	311 46 46	3836.8	4195.8	2.38
			44 05 30	Jones	224 04 59	1614.5	1765.6	1.00
Dekay	40 52 24.53	73 30 23.98	144 36 31	Centre Island	324 36 00	1889.3	2066.1	1.17
			108 59 41	Oyster Bay	288 58 10	3444.7	3767.0	2.14
Oyster Bay Academy	40 52 19.48	73 31 21.90	227 18 58	Cooper's Bluff	47 20 11	3529.7	3860.0	2.19
			123 52 26	Oyster Bay	303 51 33	2289.9	2504.2	1.42
Kirby	40 48 26.78	73 31 12.55	240 06 41	Huntington	60 10 42	9936.3	10866.0	6.17
			195 04 16	Sheep	15 04 52	4934.5	5396.2	3.07

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Townsend	40 53 01.43	73 36 17.24	271 30 35	Mill Neck	91 32 38	4473.8	4892.4	2.78
			14 29 28	Harrow	194 28 20	9829.6	10749.4	6.11
Wheatley	40 48 12.25	73 34 48.91	82 30 21	Harrow	262 28 15	4568.7	4996.2	2.84
			166 57 00	Townsend	346 56 09	9156.9	10013.7	5.69
Onderdonk	40 49 06.99	73 40 12.83	217 19 27	Townsend	37 22 00	9096.7	9947.9	5.65
			306 43 20	Harrow	126 44 45	3821.3	4178.9	2.37
LONG ISLAND SOUND. *Western part.*								
Sands' Point	40 51 59.62	73 42 48.35	258 12 15	Townsend	78 16 31	9353.7	10228.9	5.81
			325 36 41	Onderdonk	145 38 20	6452.0	7055.7	4.01
Matinicock Point	40 54 07.29	73 37 39.76	316 26 28	Townsend	136 27 23	2803.2	3065.5	1.74
			61 25 57	Sands' Point	241 22 35	8228.0	8997.9	5.11
Oak Neck Point	40 54 53.29	73 33 39.79	46 55 16	Townsend	226 53 33	5049.6	5522.1	3.14
			291 59 10	Cooper's Bluff	112 01 53	6276.2	6863.5	3.90
Little Captain's Island	40 59 22.36	73 36 10.94	0 43 10	Townsend	180 43 06	11751.6	12851.2	7.30
			34 16 57	Sands' Point	214 12 37	16521.5	18067.4	10.26
Great Captain's Island Light-house.	40 58 54.55	73 37 06.39	118 19 52	Sawpits	298 17 57	4680.0	5117.9	2.91
			236 33 23	Captain's Island	56 34 38	1554.0	1699.4	0.97
Manursing Island Point	40 58 00.44	73 39 22.87	334 45 41	Townsend	154 48 09	10194.9	11148.8	6.33
			23 22 29	Sands' Point	203 20 41	12124.1	13258.5	7.53
Glen Cove	40 51 42.61	73 38 25.54	321 57 07	Wheatley	141 59 23	8237.4	9008.2	5.12
			355 34 46	Harrow	175 35 01	7106.9	7771.9	4.41

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Glen Cove Wharf	40 51 47.49	73 39 00.32	94 01 54	Sands' Point	273 59 24	5352.6	5853.4	3.33
			121 13 52	Premium Point	301 09 51	10149.0	11098.6	6.31
Buckram	40 51 58.34	73 34 32.47	32 59 56	Harrow	212 57 39	9024.7	9869.1	5.61
			84 56 50	Glen Cove	264 54 18	5478.9	5991.6	3.41
Coles	40 51 48.42	73 36 27.58	16 58 25	Harrow	196 57 23	7595.8	8306.5	4.72
			86 17 50	Glen Cove	266 16 34	2768.4	3027.4	1.72
Poplar Hill	40 52 55.06	73 37 52.09	264 56 00	Townsend	84 57 01	2229.0	2437.6	1.39
			1 27 13	Harrow	181 27 06	9323.8	10196.2	5.79
Underhill	40 52 36.14	73 35 36.98	21 16 48	Harrow	201 15 30	9375.1	10252.3	5.82
			307 39 12	Buckram	127 40 11	1907.9	2086.4	1.18
Carpenter	40 50 52.91	73 38 24.48	354 37 15	Harrow	174 37 30	5577.5	6099.4	3.47
			249 36 23	Buckram	69 38 57	5795.7	6338.0	3.60
Carpenter's Neck	40 50 55.03	73 38 51.10	145 06 16	Delancy	325 03 24	10738.7	11743.5	6.67
			112 59 32	Mott's Point	292 58 38	2116.9	2315.0	1.31
Downing	40 50 22.11	73 37 39.66	57 09 58	Onderdonk	237 08 07	4272.1	4671.8	2.65
			6 32 22	Harrow	186 32 07	4633.1	5066.6	2.88
Hegerman	40 49 45.00	73 39 18.75	243 44 56	Downing	63 45 27	2588.3	2830.5	1.61
			332 34 32	Harrow	152 34 47	3896.0	4260.5	2.42
Cheeseman	40 49 35.94	73 38 31.53	220 28 12	Downing	40 28 46	1872.2	2047.4	1.16
			347 46 58	Harrow	167 47 17	3252.4	3556.7	2.02
Peacock Point	40 54 05.84	73 36 24.00	91 27 07	Matinicock Point	271 26 16	1773.6	1939.6	1.10
			355 26 50	Townsend	175 26 54	1993.2	2179.7	1.24

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Henry Mott	40 51 26.98	73 41 06.81	113 03 52	Sands' Point	293 02 46	2571.5	2812.1	1.60
			224 28 48	Matinicock Point	44 31 03	6933.1	7581.8	4.31
Delancey	40 55 40.51	73 43 13.71	355 01 06	Sands' Point	175 01 22	6839.1	7479.0	4.25
			296 41 06	Townsend	116 45 38	10912.1	11933.1	6.78
Mamaroneck	40 56 49.96	73 43 47.37	303 45 09	Townsend	123 50 04	12674.3	13860.2	7.88
			351 13 34	Sands' Point	171 14 13	9061.8	9909.7	5.63
Scotch Caps, (2)	40 56 06.91	73 41 42.24	11 28 16	Sands' Point	191 27 33	7783.3	8511.6	4.84
			306 55 24	Townsend	126 58 57	9517.5	10408.1	5.91
Premium Point	40 54 37.93	73 45 11.16	355 24 46	Hurtleberry Island	175 24 52	2531.2	2768.1	1.57
			325 35 16	Sands' Point	145 36 46	5917.5	6471.2	3.68
Rye Point	40 56 36.40	73 40 45.27	18 39 53	Sands' Point	198 38 32	9007.7	9850.5	5.60
			63 38 42	Delancey	243 37 04	3876.5	4239.2	2.41
Davenport's Neck	40 53 22.08	73 46 25.82	310 40 18	Harrow	130 45 47	15566.1	17022.6	9.67
			272 30 16	Townsend	92 36 53	14261.1	15595.5	8.86
Hurtleberry Island	40 53 16.13	73 45 02.52	315 19 13	Harrow	135 23 49	14013.4	15324.6	8.71
			272 03 52	Townsend	92 09 36	12305.2	13456.6	7.64
Red Spring	40 52 37.49	73 38 56.42	77 53 00	Sands' Point	257 50 28	5554.8	6074.6	3.45
			133 10 33	Delancey	313 07 44	8254.2	9026.5	5.13
Mott's Point	40 51 21.82	73 40 14.32	152 15 28	Delancey	332 13 30	9017.0	9860.7	5.60
			217 59 52	Red Spring	38 00 54	2962.4	3239.6	1.84
Hart Island	40 50 40.67	73 45 46.86	239 45 49	Sands' Point	59 47 46	4838.4	5291.1	3.01
			290 14 13	Ouderdonk	110 17 55	8342.4	9123.0	5.18

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Sands' Point Light-house....	40 51 54.63	73 43 27.56	55 02 58	Hart Island	235 01 36	3980.2	4352.6	2.47
			138 31 15	Hurtleberry Island	318 30 13	3355.9	3669.9	2.08
Barker's Point.............	40 50 50.93	73 43 50.76	159 26 28	Hurtleberry Island	339 25 41	4783.9	5231.5	2.97
			83 23 30	Hart Island	263 21 58	2738.0	2994.2	1.70
Kissam	40 46 53.16	73 42 31.06	253 41 02	Harrow	73 43 50	6565.9	7180.3	4.08
			218 06 20	Onderdonk	38 07 50	5246.4	5737.3	3.26
High Island	40 51 31.38	73 46 47.04	217 07 49	Hurtleberry Island	37 08 57	4053.5	4432.8	2.52
			295 42 41	Onderdonk	115 47 00	10253.1	11212.5	6.37
Beaconhill	40 49 57.93	73 40 19.65	354 10 39	Onderdonk	174 10 40	1580.5	1728.4	0.98
			107 39 25	High Island	287 34 59	9520.1	10410.9	5.92
S. S. Smith...............	40 48 34.27	73 44 01.06	243 31 47	Beacon Hill................	63 34 22	5793.6	6335.7	3.60
			144 33 52	High Island	324 32 01	6705.2	7332.6	4.17
J. W. Mott...............	40 48 57.07	73 42 55.61	242 47 21	Beacon Hill	62 48 55	4107.9	4492.3	2.55
			159 48 31	Barker's Point..............	339 47 58	3741.8	4091.9	2.32
Cornwell	40 50 28.08	73 43 05.09	283 28 21	Beacon Hill	103 30 09	3985.1	4358.0	2.48
			20 29 15	S. S. Smith	200 28 27	3746.6	4097.2	2.33
Hicks	40 48 28.06	73 42 48.73	251 47 31	Onderdonk	71 49 13	3845.7	4205.5	2.39
			174 05 14	Cornwell	354 05 12	3721.8	4070.1	2.31
Mitchell's Bluff	40 49 28.50	73 41 56.74	248 13 25	Beacon Hill	68 14 29	2449.5	2678.7	1.52
			112 27 43	Hart Island.................	292 25 13	5833.0	6378.8	3.63
Mitchell, (2)...............	40 49 28.46	73 41 56.84	248 13 17	Beacon Hill	68 14 21	2451.6	2681.0	1.52
			138 59 49	Cornwell	318 59 04	2436.6	2664.6	1.51

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Great Neck	40 48 50.26	73 45 19.78	253 26 23	Beacon Hill	73 29 42	7335.1	8021.4	4.56
			157 38 49	High Island	337 37 42	5373.3	5876.1	3.34
Hammond	40 48 37.52	73 48 06.01	199 01 24	High Island	19 02 10	5672.5	6203.3	3.53
			264 13 14	Great Neck	84 15 07	3915.1	4281.4	2.43
Wilkins' Point	40 47 42.50	73 46 28.62	190 05 31	Hart Island	10 05 58	5582.4	6104.8	3.47
			126 38 23	Hammond	306 37 19	2844.2	3110.3	1.77
City Island	40 50 19.57	73 46 43.20	310 29 09	S. S. Smith	130 30 53	5000.5	5468.4	3.11
			256 32 00	Barker's Point	76 34 06	4156.3	4545.2	2.58
Rodman's Neck	40 51 18.96	73 47 46.92	290 54 00	Onderdonk	110 58 57	11389.3	12455.0	7.08
			259 47 58	Sands' Point	79 51 13	7103.1	7767.7	4.41
Bownes	40 45 24.93	73 44 56.92	231 29 05	Kissam	51 30 40	4371.5	4780.5	2.72
			159 58 10	Rodman's Neck	339 56 19	11624.1	12711.8	7.22
Hewlett's Point	40 50 01.71	73 44 49.63	222 15 32	Barker's Point	42 16 27	2050.6	2242.5	1.27
			131 52 37	Hart Island	311 52 00	1800.5	1969.0	1.13
Little Bay Side	40 45 56.19	73 44 18.56	153 53 30	Rodman's Neck	333 51 14	11089.0	12126.6	6.89
			235 06 42	Kissam	55 07 50	3073.4	3361.0	1.91
White Stone Point	40 47 58.52	73 48 55.48	223 56 39	Hammond	43 56 55	1670.8	1827.1	1.04
			278 09 20	Wilkins' Point	98 10 39	3477.3	3802.7	2.16
Old Ferry Point	40 48 21.36	73 49 47.17	258 07 03	Hammond	78 08 09	2422.7	2649.4	1.51
			300 10 30	White Stone Point	120 11 20	1401.5	1532.6	0.87
Ferris	40 50 20.82	73 48 36.60	229 41 25	High Island	49 42 37	3364.9	3679.7	2.09
			301 10 55	Great Neck	121 13 03	5391.5	5896.0	3.35

United States Coast Survey.—Geographical Positions. Section II.—Connecticut. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Old Hen	40 52 20.46	73 42 28.59	35 44 49	Sands' Point	215 44 36	791.8	865.9	0.49
			115 29 14	Hurtleberry Island	295 27 55	3992.0	4365.5	2.48
Execution Rocks	40 52 42.24	73 43 55.97	309 41 52	Sands' Point	129 42 36	2057.9	2250.5	1.28
			34 42 48	Hart Island	214 41 35	4565.0	4992.1	2.84
Execution Buoy	40 52 41.93	73 43 48.58	312 46 17	Sands' Point	132 46 56	1921.4	2101.2	1.19
			36 31 59	Hart Island	216 30 41	4660.0	5096.0	2.90
College Point	40 47 35.88	73 50 52.12	255 39 43	White Stone Point	75 41 15	2821.4	3085.4	1.75
			227 19 40	Old Ferry Point	47 20 22	2069.8	2263.5	1.29
Success	40 45 36.43	73.42 06.23	202 14 59	Onderdonk	22 16 13	7017.4	7674.0	4.36
			244 50 38	Wheatley	64 55 18	11323.1	12382.6	7.03
CONNECTICUT.								
Loafhill	41 19 32.29	73 29 35.02	289 16 41	Tashua Hill	109 26 31	22041.4	24103.8	13.70
			352 12 18	Bald Hill	172 13 06	12605.9	13785.4	7.83
Goodsall	41 15 56.06	73 24 35.42	42 09 50	Bald Hill	222 07 21	7849.0	8583.4	4.88
			133 46 08	Loafhill	313 42 49	9646.8	10549.5	5.99
Centre Reading	41 18 58.20	73 22 37.79	35 00 33	Bald Hill	214 56 46	13959.5	15265.7	8.67
			96 13 27	Loafhill	276 08 49	9759.1	10672.3	6.06
High Ridge	41 16 21.75	73 29 49.00	276 10 02	Goodsall	96 13 27	7340.9	8027.8	4.56
			342 53 17	Bald Hill	162 54 14	6918.0	7565.3	4.30
Wheeler's Hill	41 15 11.05	73 19 21.26	146 53.16	Centre Reading	326 51 08	8367.0	9149.9	5.20
			263 23.56	Tashua Hill	83 27 01	6563.1	7177.2	4.08

United States Coast Survey.—Geographical Positions. Section II.—Connecticut. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Goodridge	41 19 39.48	73 18 29.05	77 36 31	Centre Reading	257 33 48	5922.8	6477.0	3.68
			324 49 31	Tashua Hill	144 52 01	9208.0	10069.6	5.72
Barnhill	41 20 38.02	73 10 46.59	80 30 34	Goodridge	260 25 29	10902.5	11922.6	6.77
			30 19 50	Tashua Hill	210 17 15	10812.0	11823.7	6.72
Pine-swamp Hill	41 21 06.70	73 16 09.05	276 42 12	Barnhill	96 45 45	7547.7	8253.9	4.69
			348 40 45	Tashua Hill	168 41 43	10421.5	11396.6	6.47
Riggs' Hill	41 24 41.76	73 07 28.53	61 18 00	Pine-swamp Hill	241 12 17	13793.7	15084.4	8.57
			30 52 13	Tashua Hill	210 47 27	19626.7	21463.2	12.20
Great Hill East	41 21 51.26	73 06 41.17	68 24 55	Barnhill	248 22 13	6135.3	6709.4	3.81
			168 11 13	Riggs' Hill	348 10 39	5373.1	5875.9	3.34
Hooper's Hill	41 24 54.06	72 59 43.64	59 51 59	Great Hill East	239 47 21	11219.1	12268.9	6.97
			88 01 46	Riggs' Hill	267 56 38	10802.2	11813.0	6.71
Peck's Hill	41 22 51.68	73 03 10.21	119 31 46	Riggs' Hill	299 28 55	6894.4	7539.5	4.28
			231 47 08	Hooper's Hill	51 49 25	6105.1	6676.4	3.79
Chestnut-tree Hill	41 26 24.16	73 05 22.24	42 52 47	Riggs' Hill	222 51 23	4309.9	4713.2	2.68
			334 55 05	Peck's Hill	154 56 32	7236.1	7913.2	4.50
Hicock, (2)	41 23 10.32	72 59 53.42	184 03 36	Hooper's Hill	4 03 48	3208.2	3508.4	1.99
			82 50 56	Peck's Hill	262 48 51	4607.7	5038.8	2.86
West Rock Ridge	41 25 05.35	72 56 58.45	84 49 46	Hooper's Hill	264 47 53	3851.7	4212.1	2.39
			48 53 33	Hicock, (2)	228 51 37	5395.0	5899.8	3.35
Collins' Hill	41 26 17.91	73 00 24.58	295 02 50	West Rock Ridge	115 05 02	5283.2	5777.5	3.28
			339 49 15	Hooper's Hill	159 49 34	2755.4	3013.2	1.71

United States Coast Survey.—Geographical Positions. Section II.—Connecticut. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Huddenston's Hill..........	41 26 54.73	72 58 04.51	335 34 23	West Rock Ridge...........	155 35 07	3703.4	4049.9	2.30
			70 47 58	Collins' Hill.................	250 46 30	3445.6	3768.0	2.14
Sandford, (near Mt. Carmel).	41 28 05.31	72 56 53.50	37 07 24	Huddenston's Hill...........	217 06 37	2730.6	2986.1	1.70
			308 20 08	Mount Carmel...............	128 22 39	6753.1	7385.0	4.20
Mount Ephraim............	41 27 45.12	72 54 36.34	329 21 55	Mount Carmel...............	149 22 55	4146.1	4534.0	2.58
			101 05 12	Sandford.....................	281 03 41	3243.1	3546.6	2.02
Cheshire Spire............	41 29 50.45	72 53 51.87	52 25 43	Sandford.....................	232 23 43	5317.0	5814.5	3.30
			351 43 52	Mount Carmel...............	171 44 23	7511.9	8214.8	4.67
Wallingford Spire..........	41 27 13.42	72 48 48.11	98 08 01	Sandford.....................	278 02 40	11376.7	12441.2	7.07
			66 34 29	Mount Carmel...............	246 31 39	6508.2	7117.2	4.04
Dickerman................	41 25 04.59	72 55 22.05	192 05 19	Mount Ephraim..............	12 05 50	5064.2	5538.0	3.15
			246 25 38	Mount Carmel...............	66 27 09	3462.7	3786.7	2.15
No Name..................	41 26 39.02	72 57 10 33	240 16 41	Mount Ephraim..............	60 18 23	4114.4	4499.4	2.56
			285 01 25	Mount Carmel...............	105 04 07	5888.9	6439.9	3.66
Lebanon..................	41 26 24.19	72 59 18.61	306 45 34	West Rock Ridge...........	126 47 07	4062.4	4442.5	2.52
			7 42 10	Hicock, (2)..................	187 41 47	6034.5	6599.1	3.75
Slate Hill..................	41 22 25.78	72 58 31.84	203 46 34	West Rock Ridge...........	23 47 36	5379.2	5882.5	3.34
			125 56 53	Hicock, (2)..................	305 55 59	2341.1	2560.2	1.45
Mount Prospect...........	41 28 20.31	72 57 55.97	15 55 38	Hicock, (2)..................	195 54 20	9943.2	10873.6	6.18
			70 57 29	Chestnut-tree Hill..........	250 52 38	10958.3	11983.7	6.81
Summerville...............	41 20 30.34	73 03 08.29	222 31 25	Hicock, (2)..................	42 33 34	6698.0	7324.7	4.16
			164 06 04	Chestnut-tree Hill..........	344 04 40	11349.1	12411.0	7.05

United States Coast Survey.—Geographical Positions. Section II.—Connecticut. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Skagerat	41 24 48.32	73 02 48.56	89 27 56	Riggs' Hill	269 24 51	6502.1	7110.5	4.04
			45 27 14	Great Hill East	225 24 43	7585.0	8294.7	4.71
Newtown	41 25 49.47	73 01 44.41	75 22 59	Riggs' Hill	255 19 11	8258.3	9031.0	5.13
			43 11 55	Great Hill East	223 08 40	10074.2	11016.8	6.26
Moose Hill East	41 24 03.18	73 06 35.21	294 49 59	Peck's Hill	114 52 19	5246.6	5737.5	3.26
			201 15 34	Chestnut-tree Hill	21 16 27	4667.1	5103.8	2.90
Rock-house Hill	41 23 02.54	73 08 01.93	194 10 00	Riggs' Hill	14 13 42	3157.4	3452.8	1.96
			319 27 13	Great Hill East	139 31 25	2890.7	3161.2	1.80
Blackburn Hill	41 21 32.95	73 11 22.98	223 03 32	Riggs' Hill	43 06 06	7974.0	8720.1	4.95
			83 05 03	Pine-swamp Hill	263 01 54	6698.0	7324.7	4.16
White Hill Church	41 20 00.35	73 08 32.13	100 57 12	Pine-swamp Hill	280 51 33	10815.6	11827.6	6.72
			46 26 40	Tashua Hill	226 22 36	11852.5	12961.5	7.36
Moose Hill	41 19 09.32	73 11 45.91	95 42 19	Goodridge	275 37 53	9420.7	10302.2	5.85
			31 43 52	Tashua Hill	211 41 56	7756.3	8482.1	4.82
South Whitehill	41 19 10.51	73 07 36.01	89 39 42	Moose Hill	269 36 56	5811.6	6355.4	3.61
			56 11 15	Tashua Hill	236 06 34	11910.6	13025.1	7.40
Booth	41 16 40.03	73 10 46.07	223 35 18	South Whitehill	43 37 24	6410.7	7010.6	3.98
			70 00 33	Tashua Hill	249 57 58	5822.9	6367.8	3.62
Hawley	41 19 15.06	73 14 35.33	97 54 46	Goodridge	277 52 12	5486.7	6000.1	3.41
			1 08 48	Tashua Hill	181 08 44	6776.6	7410.7	4.21
Monroe Tall Spire	41 19 56.41	73 12 06.74	86 40 22	Goodridge	266 36 09	8904.7	9737.9	5.43
			24 03 42	Tashua Hill	204 02 00	8816.0	9640.9	5.48

United States Coast Survey.—Geographical Positions. Section II.—Connecticut. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ″ ′		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Trumbull	41 17 44.51	73 15 24.36	49 22 11	Wheeler's Hill	229 19 35	7266.4	7946.3	4.51
			345 49 44	Tashua Hill	165 50 13	4107.2	4491.5	2.55
Tashua Church	41 17 10.88	73 15 18.71	56 48 19	Wheeler's Hill	236 45 39	6747.2	7378.5	4.19
			343 27 58	Tashua Hill	163 28 23	3071.6	3359.0	1.91
Weston Spire	41 14 59.19	73 17 50.42	117 15 49	Loafhill	297 08 02	18439.7	20155.3	11.45
			74 35 48	Bald Hill	254 28 52	15249.5	16676.4	9.47
Dead-tree Hill	41 17 10.75	73 18 39.36	14 47 50	Wheeler's Hill	194 47 22	3818.7	4176.0	2.37
			297 55 24	Tashua Hill	117 58 01	6275.0	6862.1	3.90
Reading Ridge	41 18 08.66	73 20 52.17	102 01 27	Loafhill	281 55 39	12429.8	13592.9	7.72
			46 35 25	Bald Hill	226 30 28	14410.3	15758.7	8.95
Ridgefield, (Presbyterian ch.)	41 16 28.03	73 29 32.83	278 04 55	Goodsall	98 08 10	6991 4	7645.6	4.34
			346 18 08	Bald Hill	166 18 55	7005.0	7660.5	4.35
Reading Spire	41 18 47.27	73 20 44.22	96 28 08	Loafhill	276 22 21	12421.5	13583.8	7.72
			43 50 35	Bald Hill	223 45 35	15380.2	16819.3	9.56
Picket's Ridge	41 19 27.03	73 26 51.37	92 28 17	Loafhill	272 26 29	3808.8	4165.2	2.37
			35 53 46	High Ridge	215 51 46	7051.1	7710.9	4.38
Baker's Hill	41 18 26.89	73 31 00.24	224 28 50	Loafhill	44 29 46	2828.3	3093.0	1.76
			336 45 08	High Ridge	156 45 52	4199.4	4592.3	2.61
Patrick	41 17 33.80	73 30 58.56	288 38 49	Goodsall	108 43 04	9410.0	10290.5	5.85
			323 55 26	High Ridge	143 56 16	2749.2	3006.4	1.71
Hanford	41 14 59.84	73 30 57.30	318 23 57	Bald Hill	138 25 40	5462.2	5973.3	3.39
			212 10 23	High Ridge	32 11 09	2985.1	3264.4	1.85

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Hayes' Ridge	41 13 43.75	73 30 55.73	295 49 33	Bald Hill	115 51 15	3988.2	4361.4	2.48
			179 06 23	Hanford	359 06 22	2445.6	267[illegible] 4	1.52
Wills	41 12 12.86	73 30 23.91	249 28 59	Bald Hill	69 30 20	3041.5	3326.1	1.89
			165 11 36	Hayes' Ridge	345 11 15	2900.1	3171.5	1.80
Cravenbush	41 10 39.74	73 30 54.46	222 06 46	Bald Hill	42 08 27	5309.1	5805.9	3.30
			179 42 02	Hayes' Ridge	359 42 01	5675.9	6207.0	3.53
Craven Tree	41 10 39.63	73 30 54.96	222 10 59	Bald Hill	42 12 40	5319.4	5817.1	3.31
			179 49 09	Hayes' Ridge	359 49 09	5679.2	6210.6	3.53
LONG ISLAND SOUND.								
From Housatonic river westw'd.								
Bennet	41 16 37.72	73 05 45.56	311 26 50	South Milford	131 30 02	9021.0	9865.1	5.60
			242 35 56	West Rock	62 41 30	13180.0	14413.3	8.19
Stratford Point	41 09 26.27	73 06 45.91	228 03 32	South Milford	48 07 23	10979.0	12006.3	6.82
			186 01 14	Bennet	6 01 53	13382.0	14634.2	8.31
Sherwood	41 12 06.58	73 13 03.89	230 37 40	Bennet	50 42 30	13194.1	14428.7	8.20
			299 16 36	Stratford Point	119 20 47	10102.6	11047.9	6.28
Stratford Hill	41 13 05.95	73 08 50.56	267 04 25	South Milford	87 09 36	11084.0	12121.1	6.89
			213 22 52	Bennet	33 24 51	7824.0	8556.1	4.86
Gunn	41 13 54.10	73 04 37.76	19 52 52	Stratford Point	199 51 30	8784.6	9606.6	5.46
			75 51 30	Stratford Hill	255 48 53	6072.0	6640.2	3.77
Old Farms	41 14 50.66	73 08 58.59	356 41 05	Stratford Hill	176 41 10	3235.0	3537.7	2.01
			285 59 48	Gunn	106 02 35	6319.5	6910.8	[illegible].93

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Chestnut	41 14 11.07	73 13 54.41	285 49 09	Stratford Hill	105 52 29	7355.7	8044.0	4.57
			259 55 00	Old Farms	79 58 15	6995.0	7649.5	4.35
Stratford Light-house	41 09 04.77	73 05 52.95	220 54 46	South Milford	40 58 06	10585.9	11576.4	6.58
			118 13 41	Stratford Point	298 13 08	1401.6	1532.7	0.87
Stratford Beacon	41 09 44.65	73 05 54.61	225 50 36	South Milford	45 53 55	9717.0	10626.2	6.04
			64 37 36	Stratford Point	244 37 02	1323.0	1446.8	0.82
Stratford Spire, (cock)	41 11 17.02	73 07 29.94	150 47 52	Stratford Hill	330 46 58	3849.0	4209.1	2.39
			120 58 29	Chestnut	300 54 16	10441.0	11418.0	6.49
Stratford Spire, (hen)	41 11 30.42	73 07 31.27	119 04 36	Chestnut	299 00 24	10208.0	11163.2	6.34
			147 55 36	Stratford Hill	327 54 44	3477.0	3802.3	2.16
Charles' Island Poplar	41 11 25.45	73 02 58.79	55 10 42	Stratford Point	235 08 13	6449.0	7052.4	4.01
			153 16 20	Gunn	333 15 15	5124.0	5603.5	3.18
Milford Spire	41 13 34.23	73 03 12.85	230 41 19	Prindle	50 43 58	7233.0	7909.8	4.49
			107 14 26	Gunn	287 13 30	2072.0	2265.9	1.29
Black Rock, (1)	41 08 36.48	73 12 37.06	259 20 36	Stratford Point	79 24 27	8329.0	9108.3	5.18
			174 29 23	Sherwood	354 29 05	6511.0	7120.2	4.05
Black Rock Light-house	41 08 30.11	73 12 43.87	176 00 32	Sherwood	356 00 19	6694.0	7320.4	4.16
			212 33 20	Stratford Hill	32 35 54	10097.0	11041.8	6.27
Black Rock, (2)	41 08 32.56	73 12 37.94	258 33 33	Stratford Point	78 37 25	8373.2	9156.7	5.21
			174 46 00	Sherwood	354 45 43	6629.5	7249.8	4.12
Bridgeport North Spire	41 10 35.20	73 11 06.36	289 17 29	Stratford Point	109 20 20	6432.5	7034.4	4.00
			30 00 19	Black Rock, (1)	209 59 18	4230.0	4625.8	2.63

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Bridgeport Middle Spire	41 10 32.33	73 11 04.66	136 17 39	Sherwood	316 16 01	4021.5	4379.8	2.50
			213 22 57	Stratford Hill	33 24 06	5673.3	6204.2	3.53
Bridgeport South Spire	41 10 30.07	73 11 03.78	288 07 08	Stratford Point	108 08 57	6324.9	6916.7	3.93
			31 49 33	Black Rock, (1)	211 48 33	4125.2	4511.2	2.56
Johnson	41 10 02.41	73 09 43.91	56 43 10	Black Rock, (1)	236 41 09	4829.0	5280.9	3.00
			285 02 18	Stratford Point	105 04 07	4296.0	4698.0	2.67
Milford Point	41 09 47.10	73 04 19.25	215 22 19	S. Milford	35 24 31	8207.7	8975.7	5.10
			134 09 22	Stratford Hill	314 06 23	8808.5	9632.7	5.47
Gould	41 10 55.06	73 16 18.23	244 19 16	Sherwood	64 21 24	5023.0	5493.0	3.12
			309 51 22	Black Rock, (1)	129 52 25	6716.0	7344.4	4.17
Pine Creek Point, (1)	41 07 03.84	73 15 22.22	233 24 40	Black Rock, (1)	53 25 06	4794.0	5220.7	2.97
			169 40 11	Gould	349 39 34	7280.0	7961.2	4.52
Fairfield	41 09 21.47	73 15 13.62	2 41 48	Pine Creek Point, (1)	182 41 42	4250.0	4647.7	2.64
			290 49 39	Black Rock, (1)	110 50 00	3904.0	4269.3	2.43
Fairfield Spire	41 08 33.49	73 14 41.52	19 00 55	Pine Creek Point, (1)	198 56 27	2902.0	3173.5	1.80
			268 15 03	Black Rock, (1)	88 11 01	2923.7	3197.3	1.82
Pavement	41 11 34.88	73 16 57.23	312 54 55	Black Rock, (2)	132 57 46	8255.0	9027.4	5.13
			259 46 49	Sherwood	79 49 23	5523.0	6039.8	3.43
Pine Creek Point, (2)	41 07 11.46	73 15 13.78	235 29 14	Black Rock, (2)	55 30 59	4416.0	4829.2	2.74
			163 30 43	Pavement	343 29 35	8474.0	9266.9	5.27
Cumpo	41 06 47.53	73 20 40.42	264 25 51	Pine Creek Point, (2)	84 29 26	7650.0	8365.8	4.75
			210 23 42	Pavement	30 26 09	10278.0	11239.7	6.39

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Gorham	41 10 57.79	73 23 25.63	262 45 27	Pavement	82 49 43	9122.8	9976.4	5.67
			333 27 51	Cumpo	153 29 39	8627.0	9434.2	5.36
Merwin	41 14 06.65	73 19 37.30	321 24 34	Pavement	141 26 20	5987.0	6547.2	3.72
			42 23 19	Gorham	222 20 49	7885.0	8622.8	4.90
Jackson	41 15 04.19	73 16 40.27	3 29 45	Pavement	183 29 34	6468.0	7073.2	4.62
			66 44 21	Merwin	246 42 24	4491.0	4911.2	2.79
W. Hubbel	41 10 14.84	73 15 16.89	221 56 42	Sherwood	41 58 10	4635.0	5068.7	2.88
			309 08 35	Black Rock, (1)	129 10 00	4805.0	5254.6	2.99
Thorp	41 07 56.69	73 18 48.98	288 39 12	Pine Creek Point, (1)	108 41 29	5090.0	5566.3	3.16
			212 24 19	Gould	32 25 58	6554.0	7167.3	4.07
Mill Hill	41 08 46.82	73 16 22.29	181 20 54	Gould	1 20 57	3984.0	4356.8	2.48
			65 38 41	Thorp	245 37 05	3755.0	4106.4	2.33
Bradley	41 10 51.42	73 17 10.39	315 32 06	Fairfield	135 33 24	3886.0	4249.6	2.42
			263 16 10	Gould	83 16 44	1223.0	1337.4	0.76
Adams	41 09 01.00	73 19 16.42	229 28 07	Gould	49 30 04	5463.0	5974.2	3.40
			342 06 53	Thorp	162 07 11	2084.0	2279.0	1.30
Levi Hubbel	41 08 39.71	73 20 00.31	308 34 31	Thorp	128 35 18	2127.0	2375.2	1.35
			237 17 31	Adams	57 18 00	1215.0	1328.7	0.75
Farms Point	41 06 53.07	73 18 14.72	157 50 32	Thorp	337 50 09	2118.0	2316.2	1.32
			265 15 37	Pine Creek Point, (1)	85 17 30	4037.0	4414.7	2.51
Handford	41 09 04.24	73 22 06.93	152 21 51	Gorham	332 21 00	3953.0	4322.9	2.46
			200 27 09	Merwin	20 28 47	9956.0	10887.6	6.19

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Brown	41 09 59 29	73 25 27.62	289 55 36	Handford	109 57 47	4976.0	5441.6	3.09
			237 35 08	Gorham	57 36 28	3367.0	3682.0	2.09
Cockenoe's Island	41 04 58.89	73 21 00.66	243 08 44	Pine Creek Point, (2)	63 12 32	9063.0	9911.0	5.63
			188 01 01	Cumpo	8 01 14	3384.0	3700.6	2.10
St. John	41 06 55.76	73 25 11.83	272 16 04	Cumpo	92 19 02	6336.0	6928.9	3.94
			198 20 16	Gorham	18 21 25	7865.0	8600.9	4.89
Nash	41 06 02.19	73 25 21.57	187 49 44	St. John	7 49 51	1667.0	1823.0	1.04
			257 56 06	Cumpo	77 59 11	6706.0	7333.5	4.17
Calf-pasture Island	41 04 53.79	73 22 43.50	219 17 40	Cumpo	39 19 01	4533.0	4957.2	2.82
			137 23 39	St. John	317 22 02	5111.0	5589.2	3.18
Brushy Ridge	41 09 21.76	73 28 40.90	292 57 31	Cumpo	113 02 47	12173.0	13312.0	6.35
			248 00 55	Gorham	68 04 22	7923.0	8664.4	4.92
Copp's Island	41 03 31.87	73 22 55.36	207 32 28	Cumpo	27 33 57	6807.0	7443.9	4.23
			143 16 17	Brushy Ridge	323 12 29	13471.0	14731.5	8.37
Ram Island	41 03 30.29	73 23 52.41	216 20 58	Cumpo	36 23 04	7556.0	8263.0	4.70
			267 53 08	Copp's Island	87 53 45	1332.0	1456.6	0.83
Chimon's Island	41 04 00.71	73 23 09.20	213 59 37	Cumpo	34 01 15	6207.0	6787.8	3.86
			340 02 05	Copp's Island	160 02 14	946.4	1035.0	0.59
Tavern Island	41 03 36.57	73 25 00.72	189 14 47	Gorham	9 15 49	13789.0	15079.2	8.64
			225 51 30	Cumpo	45 54 21	8461.0	9244.7	5.26
Lockwood	41 05 32.00	73 28 44.13	180 36 25	Brushy Ridge	0 36 26	7087.0	4746.9	4.40
			294 26 19	Copp's Island	114 30 08	8944.0	9780.9	5.56

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Greenwich Point, (2)	41 00 07.36	73 33 57.31	295 01 42	Eaton	115 08 44	16629.9	18186.0	10.33
			343 02 31	Sheep	163 04 54	17619.5	18868.2	10.95
Long Neck	41 02 08.56	73 28 20.75	326 17 18	Eaton	146 20 40	12966.5	14179.8	8.06
			64 35 55	Greenwich Point, (2)	244 32 15	8705.9	9520.5	5.41
Shippan Point	41 01 09.67	73 31 04.27	309 07 29	Eaton	129 12 38	14207.0	15536.3	8.83
			64 35 11	Greenwich Point, (2)	244 33 17	4476.3	4895.2	2.78
Sheffield Island Light-house	41 02 52.81	73 24 50.54	187 32 07	Gorham	7 33 03	15090.1	16502.1	9.38
			218 51 25	Cumpo	38 54 00	9300.4	10170.6	5.78
Fish Island	41 02 51.82	73 27 08.16	51 47 58	Long Neck	231 47 10	2157.3	2359.4	1.34
			335 36 00	Eaton	155 38 34	13310.5	14556.0	6.42
Sheffield Island, (2)	41 02 47.67	73 25 01.56	348 03 22	Eaton	168 04 33	12260.9	13408.1	7.62
			68 29 19	Greenwich Point, (2)	248 23 27	13456.3	14715.4	8.36
Palmer	41 03 38.30	73 33 46.16	270 41 08	Copp's Island	90 48 17	15195.0	16616.8	9.44
			213 52 49	Brushy Ridge	33 56 10	12765.7	13950.2	7.93
Stanwich	41 06 30.81	73 36 30.73	244 15 45	Brushy Ridge	64 20 54	12168.0	13306.6	7.56
			324 05 37	Palmer	144 07 25	6565.3	7179.6	4.08
Purdy	41 03 07.52	73 41 16.06	264 47 28	Palmer	84 52 24	10547.0	11533.9	6.55
			226 40 13	Stanwich	46 43 21	9139.9	9995.1	5.68
Munro	40 56 08.94	73 45 53.61	324 08 50	Harrow	144 13 59	18866.9	20632.3	11.72
			203 36 45	Round Hill	23 40 33	20260.6	22156.4	12.59
Port Chester, (station)	41 00 06.53	73 40 02.71	338 04 39	Townsend	158 06 58	14135.8	15758.5	8.78
			14 28 40	Sands' Point	194 26 52	15513.3	16964.9	9.64

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Sandford	41 01 10.85	73 39 36.92	304 47 36	Little Captain's Island	124 50 45	5863.0	6411.6	3.64
			16 53 51	Port Chester	196 53 34	2073.0	2267.0	1.29
Port Chester, (flag-staff)	40 59 54.19	73 39 18.78	169 50 23	Sandford	349 50 01	2402.0	2626.8	1.49
			110 21 38	Port Chester	290 21 09	1095.0	1197.5	0.68
Close	41 04 45.24	73 37 43.74	290 23 45	Palmer	110 26 21	5917.8	6471.5	3.68
			20 41 41	Port Chester	200 40 09	9188.7	10048.5	5.71
Hobby	41 03 32.68	73 36 39.38	267 31 35	Palmer	87 33 29	4048.0	4426.8	2.52
			355 04 17	Little Captain's Island	175 05 30	7750.7	8475.9	4.82
Webb	41 06 52.42	73 33 49.85	359 10 29	Palmer	179 10 31	5988.3	6548.6	3.72
			79 55 48	Stanwich	259 54 02	3820.0	4177.4	2.37
Norroton	41 03 14.11	73 30 32.99	99 24 00	Palmer	279 21 53	4570.6	4998.3	2.84
			47 51 41	Little Captain's Island	227 48 00	10650.0	11646.6	6.62
Norroton Point	41 03 16.80	73 25 59.23	57 31 11	Long Neck	237 29 38	3918.1	4284.7	2.43
			343 13 33	Eaton	163 15 22	13466.2	14726.2	8.37
Southport Spire	41 08 04.65	73 16 34.68	46 35 18	Copp's Island	226 31 08	12235.3	13380.2	7.66
			98 03 46	Brushy Ridge	277 55 38	17100.0	18700.0	10.62
Norwalk Spire	41 07 05.34	73 24 09.85	188 10 39	Gorham	8 11 08	7243.7	7921.5	4.50
			78 26 32	St. John	258 25 51	1475.7	1613.8	0.92
Horse Neck Spire	41 02 03.47	73 37 04.40	49 07 49	Port Chester	229 05 53	5510.3	6025.9	3.42
			345 52 56	Little Captain's Island	165 54 15	5125.3	5603.9	3.18
Stamford Spire, (northeast)	41 03 12.11	73 31 43.09	132 22 40	Stanwich	312 19 26	9092.2	9942.9	5.65
			267 49 50	Norroton	87 50 36	1637.9	1791.2	1.02

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Stamford Spire, (southwest)	41 03 10.19	73 32 01.96	134 35 21	Stanwich	314 32 19	8813.0	9637.6	5.48
			266 39 53	Norroton	86 40 51	2081.0	2275.7	1.29
Davenport	41 07 32.10	73 31 22.67	315 02 36	Lockwood	135 03 16	5234.9	5724.7	3.26
			351 43 13	Norroton	171 42 41	8041.6	8794.1	5.00
Scofield	41 08 18.35	73 34 32.93	329 09 16	Norroton	149 11 54	10927.7	11950.2	6.79
			287 48 23	Davenport	107 51 32	4660.8	5096.9	2.90
VICINITY OF NEW YORK.								
Quimby	41 08 42.74	73 43 52.77	311 31 27	Round Hill	131 33 52	7073.7	7735.6	4.40
			57 24 11	Buttermilk Hill	237 21 16	7371.3	8061.0	4.58
Rockhill	41 09 41.12	73 43 02.78	51 58 01	Buttermilk Hill	231 54 49	9367.9	10245.1	5.82
			327 32 52	Round Hill	147 35 05	7691.8	8411.5	4.78
Sarles	41 08 55.39	73 46 59.60	275 06 07	Quimby	95 08 10	4373.7	4783.0	2.72
			22 59 24	Buttermilk	202 58 32	4740.3	5183.9	2.95
Hunt's Hill	41 11 05.78	73 45 46.41	22 59 30	Sarles	202 58 42	4368.8	4777.6	2.71
			329 00 31	Quimby	149 01 46	5146.3	5627.8	3.20
Knapp	41 12 17.17	73 41 45.12	49 41 55	Sarles	229 38 26	9615.5	10515.2	5.98
			24 14 20	Quimby	204 12 57	7249.9	7928.3	4.50
Bussing	41 09 33.82	73 40 27.59	160 17 03	Knapp	340 16 11	5350.1	5850.7	3.32
			71 47 18	Quimby	251 45 03	5036.4	5507.7	3.13
Aspen Hill	41 13 34.20	73 38 25.57	20 59 30	Bussing	200 58 09	7940.9	8683.9	4.93
			62 54 54	Knapp	242 52 42	5220.1	5708.5	3.24

United States Coast Survey.—Geographical Positions. Section II.—Vicinity of New York. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Bedford Spire	41 12 25.52	73 38 30.26	86 44 33	Knapp	266 42 23.	4545.6	4970.9	2.83
			182 57 12	Aspen Hill	2 57 14	2121.3	2309.8	1.32
Great Hill	41 10 56.02	73 36 15.45	66 41 10	Bussing	246 38 24	6400.5	6999.4	3.98
			148 09 34	Aspen Hill	328 08 09	5743.8	6281.3	3.57
Poundridge	41 13 01.53	73 34 06.15	37 53 53	Great Hill	217 52 31	4905.2	5364.2	3.05
			99 29 24	Aspen Hill	279 26 33	6125.1	6698.2	3.80
Poundridge Church	41 12 29.86	73 34 10.37	108 29 14	Aspen Hill	288 26 26	6271.4	6858.2	3.90
			58 21 06	Bussing	238 16 57	10335.4	11302.5	6.42
Ambler	41 12 21.06	73 37 14.19	143 37 15	Aspen Hill	323 36 29	2802.5	3064.7	1.74
			88 54 56	Knapp	268 51 58	6311.5	6902.1	3.92
Prospect	41 11 03.19	73 40 34.49	144 10 22	Knapp	324 09 34	2811.2	3074.2	1.75
			46 52 17	Quimby	226 50 06	6335.1	6927.9	3.93
Vail's Pole	41 11 55.30	73 50 47.75	282 14 29	Hunt's Hill	102 17 46	7185.7	7858.1	4.46
			316 12 05	Sarles	136 14 35	7685.7	8404.8	4.78
Kakeout Hill	41 05 18.17	73 50 22.13	230 53 03	Buttermilk Hill	50 54 24	3703.4	4049.9	2.30
			215 10 07	Sarles	35 12 21	8198.4	8965.5	5.09
Fields West	41 02 14.86	73 43 14.48	311 25 16	Port Chester	131 27 22	5976.0	6535.2	3.71
			18 14 41	Munro	198 12 57	11883.0	12994.9	7.38
Theal	40 58 13.46	73 41 39.17	212 53 39	Port Chester	32 54 42	4150.0	4538.3	2.58
			163 20 38	Fields West	343 19 34	7765.9	8492.5	4.82
Tompkin	40 58 32.95	73 45 35.16	208 40 27	Fields West	28 42 12	7802.7	8532.8	4.85
			275 39 43	Theal	95 42 32	6005.0	6566.9	3.73

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Spyhill	40 59 45.64	73 46 15.87	265 44 22	Port Chester	85 48 27	8744.0	9562.2	5.43
			222 38 22	Fields West	42 40 21	6254.0	6839.2	3.88
Greensburgh, (2)	41 00 33.92	73 48 37.51	247 32 40	Fields West	67 36 11	8161.2	8924.8	5.07
			334 52 08	Munro	154 53 55	9026.8	9871.4	5.61
Greensburgh, (3)	40 59 31.71	73 49 31.44	240 12 49	Fields West	60 16 55	10142.0	11091.0	6.30
			320 49 17	Munro	140 51 39	8065.2	8819.8	5.01
Valentine, (2)	40 55 38.34	73 51 34.24	201 44 27	Greensburgh, (3)	21 45 38	7749.3	8474.4	4.81
			263 12 57	Munro	83 16 30	8023.9	8774.7	4.98
Shonhard	40 57 05.42	73 52 47.85	225 29 12	Greensburgh, (3)	45 31 20	6437.0	7039.3	4.00
			280 09 20	Munro	100 13 51	9843.0	10764.0	6.12
Boompes Hook	40 57 59.00	73 54 24.36	247 18 24	Greensburgh, (3)	67 21 36	7420.0	8114.3	4.61
			306 12 35	Shonhard	126 13 38	2797.0	3058.7	1.74
Didery	40 57 59.98	73 50 13.95	199 21 11	Greensburgh, (3)	19 21 39	2998.5	3279.1	1.86
			64 57 12	Shonhard	244 55 31	3972.5	4344.2	2.47
Fort Washington	40 51 08.21	73 55 59.40	6 47 18	Mount Prospect	186 46 11	20266.8	22163.1	12.59
			292 28 50	Kissam	112 37 38	20510.2	22429.3	12.74
Van Dyne	40 43 37.28	73 50 49.45	242 37 23	Kissam	62 42 49	13158.7	14389.9	8.17
			152 26 44	Fort Washington	332 23 21	15691.9	17160.2	9.75
Givan	40 52 34.26	73 50 31.76	313 00 18	Kissam	133 05 32	15411.6	16853.6	9.58
			70 57 01	Fort Washington	250 53 27	8118.0	8877.6	5.04
Throg's Neck	40 48 16.29	73 47 12.61	187 13 25	Munro	7 14 17	14694.0	16068.9	9.13
			149 38 24	Givan	329 36 14	9223.0	10086.0	5.73

United States Coast Survey.—Geographical Positions. Section II.—Vicinity of New York. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Throg's Neck Light	40 48 16.87	73 47 08.96	186 54 12	Munro	6 55 01	14667.2	16039.6	9.11
			149 07 17	Givan	329 05 04	9252.0	10117.7	5.75
Westerfeld	40 54 27.21	73 55 40.24	313 51 44	Throg's Neck	133 56 46	16493.0	18041.7	10.25
			219 06 42	Valentine, (2)	69 09 23	6159.0	6735.3	3.83
Lydecker	40 52 27.59	73 56 34.12	268 33 35	Givan	88 37 33	8492.0	9286.6	5.28
			229 59 55	Valentine, (2)	50 03 12	9164.0	10021.5	5.69
Wolf Pit	40 47 12.43	73 48 57.18	167 25 23	Givan	347 24 24	10170.2	11121.9	6.32
			273 43 18	Kissam	93 47 30	9071.9	9[illegible]20.8	5.64
Rapalyee	40 46 11.70	73 52 01.47	246 32 44	Wolf Pit	66 34 47	4709.4	5150.1	2.93
			148 39 07	Fort Washington	323 36 31	10711.2	11713.3	6.71
Polhemus	40 46 43.30	73 54 28.05	165 19 45	Fort Washington	345 18 45	8446.3	9236.6	5.25
			252 13 18	Lawrence	72 15 35	5315.0	5812.4	3.30
Wardell	40 46 23.65	73 55 35.60	176 21 57	Fort Washington	356 21 44	8794.8	9617.7	5.46
			249 02 58	Polhemus	69 03 42	1695.8	1[illegible]1.5	1.05
Great Mill Rock	40 46 48.52	73 55 58.89	274 19 07	Polhemus	94 20 06	2135.9	2335.8	1.33
			324 33 15	Wardell	144 33 30	941.9	1030.0	0.58
Leggett	40 48 51.46	73 53 02.21	297 53 57	Wolf Pit	118 01 41	6504.8	7113.4	4.04
			343 52 33	Rapalyee	163 53 13	5129.1	5609.0	3.19
Flushing Bay	40 45 27.08	73 50 48.58	218 47 06	Wolf Pit	38 48 23	4169.2	4559.3	2.59
			128 50 46	Rapalyee	308 49 59	2194.4	2399.7	1.36
Riker's Island	40 47 20.63	73 52 52 20	330 46 13	Rapalyee	150 46 46	2435.8	2663.7	1.51
			62 53 19	Polhemus	242 52 16	2524.8	2761.0	1.57

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
South Brother	40 47 44.95	73 53 33.32	323 10 04	Rapalyee	143 11 04	3592.9	3929.1	2.23
			34 00 59	Polhemus	214 00 23	2293.6	2508.2	1.42
Hunt's Point	40 48 02.92	73 52 08.19	295 04 23	Lawrence	115 05 16	1968.1	2152.3	1.22
			357 22 05	Rapalyee	177 22 10	3434.1	3755.4	2.13
Prospect Hill	40 47 02.43	73 56 57.16	279 34 10	Polhemus	99 35 48	3545.3	3877.0	2.20
			190 07 04	Fort Washington	10 07 42	7700.7	8421.3	4.78
NEW YORK BAY.								
Howard	40 37 36.73	74 05 03.89	163 34 41	Weasel	343 30 54	28862.7	31563.4	17.93
			243 19 10	Harrow	63 36 48	42542.3	46543.2	26.43
Mount Prospect	40 40 15.73	73 57 41.40	140 54 53	Weasel	320 46 16	29373.5	32122.0	18.25
			64 47 02	Howard	244 42 14	11493.6	12569.1	7.14
Highwood	40 46 07.74	74 00 44.39	338 24 11	Mount Prospect	158 26 11	11675.5	12768.0	7.25
			21 09 18	Howard	201 06 28	16897.3	18478.4	10.50
Vetts	40 44 13.52	73 54 08.90	34 14 16	Mount Prospect	214 11 58	8869.3	9699.2	5.51
			110 49 55	Highwood	290 45 37	9922.6	10851.1	6.16
Luqueer	40 40 43.56	73 59 33.42	170 33 00	Highwood	350 32 22	10136.3	11084.8	6.30
			229 35 56	Vetts	49 39 35	9997.6	10933.1	6.21
Bushwick	40 43 39.99	73 57 13.41	132 39 21	Highwood	312 37 05	6727.2	7356.7	4.18
			31 08 34	Luqueer	211 07 03	6357.5	6952.4	3.95
Stevens	40 44 38.49	74 01 06.54	288 14 14	Bushwick	108 16 47	5759.6	6298.5	3.58
			343 12 35	Luqueer	163 13 37	7563.8	8277.0	4.70

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Fort Green	40 41 28.30	73 58 14.73	340 43 17	Mount Prospect	160 43 39	2371.1	2593.0	1.47
			53 14 58	Luqueer	233 14 06	2305.7	2521.4	1.43
Brooklyn Institute	40 41 47.24	73 59 21.97	290 18 02	Fort Green	110 18 47	1682.9	1840.4	1.04
			7 47 37	Luqueer	187 47 30	1982.2	2167.7	1.23
Brooklyn, (Cath. Ch. spire)	40 41 46.86	73 58 54.18	301 42 57	Fort Green	121 43 24	1088.6	1190.5	0.68
			25 15 54	Luqueer	205 15 28	2158.6	2360.6	1.34
Van Cott	40 43 22.83	73 56 37.13	121 52 45	Bushwick	301 52 30	1002.4	1096.2	0.62
			14 39 27	Mount Prospect	194 38 47	5964.6	6522.7	3.71
New York City Hall	40 42 43.16	74 00 03.09	140 11 54	Weasel	320 04 49	23748.1	25970.2	14.76
			36 58 12	Fire Signal	216 54 58	11620.5	12707.8	7.22
Bushwick Spire	40 42 53.17	73 56 14.15	136 05 21	Bushwick	316 04 42	2004.5	2192.1	1.25
			22 52 44	Mount Prospect	202 51 47	5270.3	5763.4	3.27
Conover	40 44 10.94	73 55 31.33	267 38 11	Vetts	87 39 06	1935.3	2116.4	1.20
			22 50 08	Mount Prospect	202 48 43	7870.8	8607.3	4.89
Blackwell's Island	40 45 04.10	73 57 15.14	303 56 53	Conover	123 58 03	2935.7	3210.4	1.82
			359 06 12	Bushwick	179 06 13	2594.6	2837.4	1.61
Williamsburgh, (flag-staff)	40 43 10.45	73 57 26.54	198 41 22	Bushwick	18 41 30	961.9	1051.9	0.60
			251 45 31	Van Cott	71 45 53	1220.5	1334.7	0.76
St. John's Church Spire	40 43 13.34	74 00 04.50	257 25 40	Vetts	77 29 32	8547.4	9347.2	5.31
			328 28 13	Mount Prospect	148 29 46	6426.2	7027.5	3.99
State Prison	40 43 58.05	74 00 13.60	266 45 57	Vetts	86 50 55	8570.0	9371.9	5.33
			332 27 56	Mount Prospect	152 29 35	7733.0	8456.6	4.80

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
St. Mark's Spire	40 43 46.13	73 58 55.03	262 47 45	Vetts	82 51 05	6766.5	7399.6	4.20
			345 04 14	Mount Prospect	165 05 15	6715.3	7343.7	4.17
Almshouse	40 44 18.21	73 58 15.20	271 24 53	Vetts	91 27 35	5780.0	6320.9	3.59
			353 56 30	Mount Prospect	173 56 52	7521.0	8224.7	4.67
Waterworks	40 43 56.44	73 59 03.12	265 36 35	Vetts	85 39 47	6922.8	7570.6	4.30
			344 15 18	Mount Prospect	164 16 11	7072.5	7734.3	4.39
Williamsburgh Spire	40 42 44.19	73 57 24.75	239 02 25	Vetts	59 04 33	5357.9	5859.2	3.33
			4 52 51	Mount Prospect	184 52 40	4595.8	5025.8	2.86
Shot Tower	40 45 16.07	73 57 26.99	292 31 59	Vetts	112 34 14	5031.0	5501.7	3.13
			2 05 33	Mount Prospect	182 05 24	9269.8	10137.2	5.76
Naval Hospital, (flag-staff)	40 41 52.96	73 57 36.73	228 20 51	Vetts	48 23 07	6525.5	7136.1	4.05
			2 05 42	Mount Prospect	182 05 39	3000.6	3281.3	1.86
Navy Yard, (flag-staff)	40 42 02.40	73 58 30.63	227 01 47	Van Cott	47 02 52	3640.3	3980.9	2.26
			340 38 12	Mount Prospect	160 38 44	3486.9	3713.2	2.17
New York Trinity Ch. Spire	40 42 25.71	74 00 24.29	249 17 08	Vetts	69 21 18	9415.5	10296.5	5.85
			316 20 13	Mount Prospect	136 21 59	5540.6	6059.0	3.44
Brooklyn Trinity Ch. Spire	40 40 56.33	73 57 43.06	219 33 01	Vetts	39 35 26	7889.9	8628.2	4.90
			358 13 12	Mount Prospect	178 13 13	1252.9	1370.1	0.78
Navy Yard, (ship-house)	40 42 08.08	73 58 24.57	31 48 16	Luqueer	211 47 31	3067.5	3354.5	1.90
			343 41 35	Mount Prospect	163 42 03	3610.7	3948.6	2.24
Mount Mitchell	40 24 27.77	74 00 06.30	163 58 04	Howard	343 54 51	25321.9	27691.2	15.73
			215 34 07	Harrow	35 48 28	53359.0	58351.8	33.15

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Bloomfield	40 32 04.01	74 19 08.84	242 36 25	Howard	62 45 35	22363.7	24456.2	13.89
			297 30 00	Mount Mitchell	117 42 21	30368.2	33209.7	18.87
Toad	40 35 58.43	74 06 34.94	336 43 13	Mount Mitchell	156 47 25	23183.3	25352.6	14.40
			67 53 01	Bloomfield	247 44 50	19149.8	20941.6	11.90
Point Comfort	40 27 20.79	74 07 45.05	118 33 14	Bloomfield	298 25 48	18308.5	20021.6	11.37
			185 55 40	Toad	5 56 25	16050.2	17552.0	9.97
Sandy Hook	40 27 42.18	74 00 04.80	159 01 56	Howard	338 58 41	19641.4	21479.2	12.20
			235 05 56	Pavilion	55 15 46	26065.2	28504.1	16.20
Sandy Hook Light-house	40 27 39.41	73 59 48.69	191 26 34	Wyckoff	11 27 44	12856.1	14059.1	7.99
			234 27 59	Pavilion	54 37 40	25805.2	28219.8	16.03
Great Kills	40 32 21.06	74 06 50.38	7 58 28	Point Comfort	187 57 52	9351.8	10226.8	5.81
			311 58 46	Sandy Hook	132 03 09	12852.5	14055.1	7.98
Compton	40 26 19.74	74 05 09.94	117 18 15	Point Comfort	297 16 20	4111.1	4495.8	2.55
			168 05 04	Great Kills	348 03 45	11392.2	12458.2	7.08
Kniphausen	40 38 28.32	74 04 36.92	21 43 12	Howard	201 42 55	1712.8	1873.1	1.06
			251 12 53	Mount Prospect	71 17 24	10307.3	11271.7	6.40
Caven Point	40 41 31.36	74 03 59.07	284 42 06	Mount Prospect	104 46 17	9169.6	10027.6	5.69
			8 57 09	Kniphausen	188 56 44	5715.0	6249.8	3.55
Constable's Point	40 39 23.52	74 05 25.61	261 33 26	Mount Prospect	81 38 29	11021.2	12052.4	6.85
			326 06 05	Kniphausen	146 06 37	2051.2	2243.1	1.27
Palmerpaw	40 40 38.24	74 05 39.32	273 29 46	Mount Prospect	93 34 58	11244.7	12296.8	6.99
			351 32 22	Howard	171 32 45	5659.7	6189.3	3.52

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Bedloe's Island, (flag-staff) ..	40 41 17.48	74 02 20.85	286 09 36	Mount Prospect............	106 12 38	6832.8	7472.2	4.24
			31 30 03	Kniphausen	211 28 34	6118.3	6690.8	3.80
Gibbet Island, (tree)	40 41 55.72	74 02 05.49	74 16 08	Caven Point...............	254 14 54	2770.1	3029.3	1.72
			29 05 03	Kniphausen	209 03 24	7318.9	8003.7	4.55
Jersey City, (flag-staff)	40 42 52.43	74 01 57.20	48 51 13	Caven Point...............	228 49 53	3799.4	4154.9	2.36
			24 44 16	Kniphausen	204 42 31	8967.3	9806.4	5.57
Castle Garden, (flag-staff) ...	40 42 02.72	74 00 32.91	40 56 07	Kniphausen	220 53 28	8749.9	9568.6	5.44
			78 42 56	Caven Point...............	258 40 42	4935.4	5397.2	3.07
Governor's Island, or Fort Columbus, (flag-staff.)	40 41 27.77	74 00 40.70	297 48 57	Mount Prospect............	117 51 01	4760.9	5206.4	2.96
			60 12 48	Constable's Point	240 09 49	7710.1	8431.4	4.79
Fort Tompkins	40 36 13.27	74 03 04 33	294 24 29	Wyckoff.....	114 27 47	7851.6	8586.3	4.88
			36 36 45	Great Kills...............	216 34 18	8918.8	9753.3	5.54
Fort Hamilton............	40 36 26.05	74 01 38.71	305 19 21	Wyckoff.....	125 21 43	6296.5	6885.7	3.91
			44 09 33	Great Kills...............	224 06 09	10526.0	11510.9	6.54
Owl's Head...............	40 38 23.82	74 01 40.71	73 05 59	Howard...................	253 03 47	4990.0	5456.9	3.10
			26 00 44	Fort Tompkins	205 59 50	4479.8	4899.0	2.78
Coney Island, (NW.)	40 34 39.44	74 00 08.71	276 40 47	Wyckoff.....	96 42 11	3041.9	3326.5	1.89
			147 14 58	Fort Hamilton.............	327 14 00	3909.4	4275.2	2.42
Benson	40 35 56.02	73 59 53.86	110 35 30	Fort Hamilton.............	290 34 22	2632.0	2878.2	1.64
			8 24 26	Coney Island, (NW.)	188 24 16	2388.0	2611.5	1.48
Elm Tree	40 33 43.95	74 05 23.36	262 32 48	Wyckoff.....	82 37 16	10510.2	11493.6	6.53
			226 34 04	Fort Hamilton.............	46 36 10	7273.6	7954.2	4.52

United States Coast Survey.—Geographical Positions. Section II.—New York Bay. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Prince's Bay Light-house....	40 30 24.80	74 12 29.84	285 53 09	Sandy Hook................	106 01 11	18248.1	19955.6	11.34
			249 47 36	Wyckoff...................	69 57 02	21792.4	23831.5	13.54
Red Hook................	40 40 27.50	74 00 38.90	49 47 24	Howard....................	229 44 31	8154.2	8917.2	5.07
			20 50 59	Owl's Head................	200 50 17	4082.1	4464.1	2.54
Battery, (flag-staff).........	40 42 02.71	74.00 32.91	18 16 20	Fort Tompkins..............	198 14 41	11349.6	12411.6	7.05
			40 56 00	Kniphausen................	220 53 21	8751.0	9569.8	5.45
Romer Beacon............	40 30 44.09	74 00 30.11	153 11 12	Howard....................	333 08 14	14263.2	15597.8	8.86
			207 02 28	Wyckoff...................	27 04 05	7752.5	8477.9	4.82
Robin's Reef Light-house....	40 39 23.81	74 03 36.80	259 06 29	Mount Prospect.............	79 10 20	8499.4	9294.7	5.28
			31 47 25	Howard....................	211 46 29	3885.1	4248.6	2.41
Fire Signal..............	40 37 42.04	74 05 00.48	163 19 59	Weasel....................	343 16 10	28728.7	31416.8	17.85
			243 28 10	Harrow....................	63 45 45	42397.6	46364.7	26.34
Moncey.................	40 30 09.06	74 12 48.52	244 13 42	Great Kills................	64 17 25	9366.9	10243.4	5.82
			305 59 25	Point Comfort..............	126 02 42	8832.8	9659.3	5.49
Morgan.................	40 28 01.06	74 15 39.33	276 20 08	Point Comfort..............	96 25 16	11240.9	12292.7	6.98
			221 00 34	Toad......................	41 06 28	19515.9	21342.0	12.13
Beers..................	40 23 30.96	74 11 06.29	144 21 00	Bloomfield................	324 15 47	19483.4	21306.5	12.11
			195 27 53	Toad......................	15 28 51	23922.1	26160.5	14.86
Cole, (Staten Island).......	40 31 52.01	74 13 46.22	92 49 15	Bloomfield................	272 45 45	7601.2	8312.4	4.72
			346 17 02	Beers.....................	166 18 45	15905.8	17394.1	9.88
South Amboy.............	40 28 44.61	74 16 59.98	153 45 18	Bloomfield................	333 43 54	6857.7	7499.4	4.26
			218 15 46	Cole......................	38 17 52	7363.0	8051.9	4.57

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Ward	40 29 41.42	74 14 32.07	27 07 48	Morgan	207 07 04	3476.5	3801.8	2.16
			250 45 05	Moncey	70 46 12	2582.6	2824.3	1.61
Conasconck Point	40 27 30.90	74 10 24.21	145 10 40	Moncey	325 09 06	5945.2	6501.5	3.69
			97 12 20	Morgan	277 08 55	7480.6	8180.6	4.65
Matayan Point	40 26 50.28	74 12 19.53	173 40 46	Moncey	353 40 28	6168.7	6745.9	3.83
			245 15 57	Conaskonck Point	65 17 13	2992.1	3272.1	1.86
Chestnaquack	40 27 37.43	74 14 43.39	118 59 17	Morgan	298 58 41	1505.9	1646.8	0.94
			184 00 30	Ward	4 00 38	3833.3	4192.0	2.38
Stillwell, or Pigeon Hill	40 24 24.49	74 04 23.33	166 45 12	Great Kills	346 43 36	15100.9	16513.9	9.38
			205 49 25	Wyckoff	25 53 34	20682.6	22617.9	12.85
Perth Amboy, (south spire)	40 30 10.68	74 15 35.93	219 33 21	Cole	39 34 32	4054.1	4433.4	2.52
			124 54 51	Bloomfield	304 52 32	6110.1	6681.8	3.80
INTERIOR OF NEW JERSEY.								
Sayre	40 40 43.56	74 16 57.58	288 54 13	Howard	109 01 58	17727.5	19386.3	11.01
			10 54 39	Bloomfield	190 53 14	16319.5	17846.5	10.14
Bergen Neck	40 45 49.40	74 02 16.62	14 39 18	Howard	194 28 28	15695.0	17163.6	9.75
			135 58 39	Weasel	315 53 02	17376.8	19002.7	10.80
Crane, (2)	40 50 05.42	74 12 48.86	334 40 12	Howard	154 45 15	25539.5	27929.2	15.87
			18 37 35	Sayre	198 34 53	18285.4	19996.4	11.36
Randolph	40 36 41.81	74 23 20.32	230 17 47	Sayre	50 21 59	11681.7	12774.8	7.26
			325 21 37	Bloomfield	145 24 20	10411.2	11385.4	6.47

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Banta	40 53 09.94	74 00 39.66	9 29 59	Bergen Neck	189 28 57	13776.5	15065.6	8.56
			85 39 36	Weasel	265 32 55	14387.0	15733.2	8.94
Bury	40 50 26.17	74 05 02.57	230 36 33	Banta	50 39 21	7963.4	8708.5	4.95
			335 29 25	Bergen Neck	155 31 13	9381.1	10258.9	5.83
Vreeland	40 49 58.12	74 00 19.67	19 39 14	Bergen Neck	199 37 57	8149.6	8912.2	5.06
			108 02 31	Weasel	287 55 37	15578.2	17035.8	9.68
Cherry Hill	40 54 43.31	73 57 52.37	21 26 18	Vreeland	201 24 42	9445.6	10329.4	5.87
			77 45 51	Weasel	257 37 20	18686.9	20435.4	11.61
Aquackanonk	40 51 01.13	74 07 25.80	322 58 08	Bergen Neck	143 01 30	12039.8	13166.4	7.48
			77 14 07	Crane, (2)	257 10 38	7760.1	8486.2	4.82
Schuyler	40 46 46.28	74 08 10.17	133 15 37	Crane, (2)	313 12 39	8965.5	9804.4	5.57
			187 31 48	Aquackanonk	7 32 19	7928.2	8670.0	4.92
Kingsland	40 47 45.16	74 07 12.75	211 32 54	Bury	31 34 19	5828.3	6373.7	3.62
			297 11 17	Bergen Neck	117 14 30	7807.4	8537.9	4.85
Van Riper	40 53 34.04	74 08 04.34	349 09 52	Aquackanonk	169 10 17	4802.0	5251.3	2.98
			46 01 16	Crane, (2)	225 58 12	9262.7	10129.4	5.75
Terhune	40 51 38.11	74 04 36.76	73 56 35	Aquackanonk	253 54 44	4119.8	4505.3	2.56
			126 21 52	Van Riper	306 19 35	6033.7	6598.3	3.75
Wallace	40 44 30.41	74 10 56.09	217 01 45	Bury	37 05 37	13750.9	15037.6	8.54
			258 38 43	Bergen Neck	78 44 23	12425.7	13588.4	7.72
Bird	40 39 03.13	74 10 08.69	290 22 59	Howard	110 26 17	7641.1	8356.1	4.75
			221 26 30	Bergen Neck	41 31 38	16727.2	18292.4	10.39

United States Coast Survey.—Geographical Positions. Section II.—Interior of New Jersey. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Newark Neck	40 42 44.97	74 08 00.00	336 28 26	Howard	156 30 20	10367.6	11337.7	6.44
			23 50 25	Bird	203 49 01	7479.7	8179.6	4.65
(b)	40 40 27.31	74 06 58 15	59 53 41	Bird	239 51 37	5173.2	5657.3	3.22
			161 07 35	Newark	341 06 55	4487.0	4906.9	2.79
(a)	40 41 22.32	74 08 08.46	315 46 19	(b)	135 47 05	2367.2	2588.7	1.47
			33 20 36	Bird	213 19 18	5138.2	5619.0	3.19
(c)	40 42 40.37	74 06 09.98	93 09 00	Newark Neck	273 07 48	2585.9	2827.9	1.61
			15 24 39	(b)	195 24 07	4256.9	4655.2	2.64
Bergen, (spire)	40 43 39.51	74 03 43.22	206 52 51	Bergen Neck	26 53 47	4492.0	4912.3	2.79
			74 25 43	Newark Neck	254 22 49	6256.1	6841.5	3.89
Elizabethtown, (spire)	40 39 42.84	74 12 36.97	290 01 53	Howard	110 06 49	11332.8	12393.2	7.04
			232 06 45	Bergen Neck	52 13 31	18434.0	20158.9	11.45
Rahway, (spire)	40 36 51.04	74 16 32.11	264 57 31	Howard	85 04 59	16235.7	17754.9	10.09
			175 14 00	Sayre	355 13 43	7196.3	7869.7	4.47
Vanhorne, (2)	40 39 05.63	74 08 06.80	88 28 08	Bird	268 26 49	2864.5	3132.5	1.78
			181 21 05	Newark Neck	1 21 10	6766.9	7400.1	4.20
Shooter's Island	40 38 34.24	74 09 20.04	286 23 47	Howard	106 26 33	6274.7	6861.8	3.90
			127 57 02	Bird	307 56 30	1449.2	1584.8	0.90
Rowan	40 38 51.54	74 07 13.72	350 18 34	Toad	170 18 59	5416.0	5922.8	3.37
			94 59 06	Bird	274 57 12	4126.0	4512.1	2.56
Praal, (Staten Island)	40 37 01.78	74 11 44.57	211 02 23	Bird	31 03 27	4368.6	4777.4	2.71
			263 26 01	Howard	83 30 23	9478.3	10365.2	5.89

United States Coast Survey.—Geographical Positions. Section II.—Interior of New Jersey. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Williams, (2)	40 34 51.18	74 12 31.94	195 27 05	Praal	15 27 36	4179.2	4570.3	2.60
			256 05 13	Toad	76 09 06	8646.8	9455.9	5.37
Doty, (Staten Island)	40 33 24.29	74 12 10.39	238 53 46	Toad	58 57 24	9210.8	10072.7	5.72
			169 17 33	Williams, (2)	349 17 19	2727.2	2982.4	1.69
Ellis, (2) Staten Island	40 33 39.39	74 10 48.76	76 22 52	Doty	256 21 59	1975.9	2160.8	1.23
			132 23 13	Williams, (2)	312 22 06	3285.1	3592.5	2.04
Zellis, (2)	40 32 43.02	74 16 17.64	336 40 10	Beers	156 43 30	18538.9	20273.6	11.53
			293 48 46	Cole	113 50 24	3894.9	4259.3	2.42
Shotwell	40 32 45.43	74 15 01.06	87 39 05	Zellis, (2)	267 38 15	1803.4	1972.2	1.12
			313 05 18	Cole	133 06 06	2411.4	2637.0	1.50
Woodbridge	40 33 22.51	74 14 20.83	10 35 52	Morgan	190 35 01	10084.9	11028.5	6.27
			246 17 31	Toad	66 22 34	11964·6	13084.1	7.43
Woodbridge, (spire)	40 33 39.79	74 16 06.26	8 41 42	Zellis, (2)	188 41 35	1771.3	1937.0	1.10
			315 14 36	Cole	135 16 07	4680.4	5118.3	2.91
Throckmorton	40 15 01.08	74 10 28.68	219 59 18	Mount Mitchell	40 06 00	22831.7	24968.1	14.19
			163 19 28	Beacon Hill	343 17 36	14253.6	15587.3	8.85
Baird	40 14 07.05	74 24 31.26	265 08 28	Throckmorton	85 17 32	19983.1	21852.9	12.42
			225 49 40	Beacon Hill	45 56 53	22008.1	24067.4	13.67
Bound Brook	40 34 56.66	74 31 37.57	311 53 19	Beacon Hill	132 05 06	34713.2	27961.3	21.57
			345 20 45	Baird	165 25 15	39830.0	43556.9	24.75
Grandon	40 15 44.62	74 13 35.86	229 44 42	Mount Mitchell	49 53 26	25008.6	27348.6	15.54
			181 30 57	Beacon Hill	1 31 06	12314.6	13466.9	7.65

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Debow	40 10 55.37	74 25 16.89	250 04 44	Throckmorton	70 14 17	22327.0	24416.1	13.87
			218 26 03	Beacon Hill	38 33 45	27127.8	29666.1	16.85
Newell	40 11 41.15	74 14 05.77	182 58 45	Beacon Hill	2 59 14	19839.9	21696.3	12.33
			219 46 50	Throckmorton	39 49 10	8018.2	8768.5	4.98
Freehold Spire, (court-house)	40 15 34.38	74 16 08.50	197 16 05	Beacon Hill	17 17 52	13224.9	14462.3	8.22
			277 10 19	Throckmorton	97 19 58	8117.6	8877.2	5.04
Princeton Seminary, (cupola)	40 20 40.00	74 39 34.26	299 31 29	Baird	119 41 13	24529.9	26825.1	15.24
			264 55 42	Beacon Hill	85 12 40	37231.2	40714.9	23.13
Princeton College,* (cupola)	40 20 52.06	74 39 15.26	....	Princeton Seminary, (cupola)	....	583.0	637.6	0.36
Sandhills	40 24 27.30	74 32 19.08	277 59 09	Beacon Hill	98 11 26	27084.3	29618.6	16.83
			329 57 27	Baird	150 02 30	22089.3	24156.2	13.73
Poplar Ridge	40 22 14.30	74 42 10.75	302 51 53	Disboro'	123 01 40	25453.2	27834.8	15.82
			338 46 08	Stony Hill	158 51 06	29925.0	32725.1	18.59
Lawrenceville, (signal)	40 18 05.01	74 43 48.71	284 28 46	Disboro'	104 39 25	24471.4	26761.2	15.21
			196 43 42	Poplar Ridge	16 44 45	8028.2	8779.4	4.99
Hezel's Farm, (2)	40 18 02.77	74 40 08.69	159 38 13	Poplar Ridge	339 36 54	8275.0	9049.3	5.14
			90 47 01	Lawrenceville, (signal)	270 44 39	5196.0	5682.2	3.23
Lawrenceville, (spire)	40 17 51.00	74 43 25.25	127 58 13	Lawrenceville, (signal)	307 57 58	702.6	768.4	0.44
			265 30 40	Hezel's Farm, (2)	85 32 47	4656.0	5091.7	2.89
Mepleton, (2)	40 21 08.62	74 36 23.83	42 49 17	Hezel's Farm, (2)	222 46 51	7811.7	8542.7	4.85
			103 55 58	Poplar Ridge	283 52 13	8431.8	9220.8	5.24

United States Coast Survey.—Geographical Positions. Section II.—New Jersey and Pennsylvania. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Cold Soil, (2)	40 20 37.84	74 42 13.90	268 57 55	Princeton Seminary	88 59 38	3766.5	4118.9	2.34
			181 25 40	Poplar Ridge	1 25 42	2976.0	3254.5	1.85
Cranberry Steeple	40 18 23.68	74 30 48.32	113 53 15	Poplar Ridge	293 45 53	17606.2	19253.6	10.94
			322 01 42	Disboro'	142 04 06	8535.4	9334.1	5.30
Mount Canoe	40 19 37.76	74 51 19.98	284 34 45	Disboro'	104 50 25	35502.7	38824.7	22.06
			249 15 13	Mount Rose	69 20 33	12457.7	13623.4	7.74
Pennington Seminary	40 19 35.36	74 47 18.30	233 00 47	Mount Rose	53 03 31	7447.2	8144.0	4.63
			90 46 03	Mount Canoe	270 43 26	5705.2	6239.0	3.54
Arney	40 00 25.66	74 41 53.02	177 31 34	Mount Rose	357 30 53	39973.5	43713.8	24.84
			145 38 09	Newtown	325 38 09	32712.8	35773.7	20.33
NEW JERSEY AND PENNSYLVANIA.								
Delaware River, from Trenton to Philadelphia.								
Trenton, (Presbyterian ch. spire.)	40 13 10.23	74 45 29.54	305 32 49	Stony Hill	125 39 52	19103.1	20890.6	11.87
			5 03 12	Mount Holly	185 02 14	24275.5	26546.9	15.08
Centreville	40 09 41.77	74 49 58.70	346 33 01	Mount Holly	166 34 56	18252.5	19960.4	11.34
			224 41 45	Trenton, (Presbyterian church)	44 44 36	9047.8	9894.4	5.62
Stackhouse	40 09 56.38	74 54 42.02	178 13 03	Newtown	358 12 55	9384.1	10262.2	5.83
			313 56 49	Arney	134 05 04	25330.7	27760.9	15.74
Wynkoop	40 12 56.90	74 58 25.74	232 38 12	Newtown	52 40 29	6284.6	6872.7	3.91
			316 26 07	Stack-house	136 28 31	7680.9	8399.6	4.77

United States Coast Survey.—Geographical Positions. Section II.—New Jersey and Pennsylvania. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Attleboro' Academy, (cupola).	40 10 50.63	74 54 58.27	180 41 16	Newtown	0 41 19	7706.6	8427.7	4.79
			128 27 20	Wynkoop	308 25 06	6263.6	6849.7	3.89
Thomas	40 13 11.92	74 58 00.17	232 39 23	Newtown	52 41 23	5523.0	6039.8	3.43
			315 21 07	Attleboro' Academy Cupola	135 23 04	6122.6	6695.5	3.80
Watson	40 12 11.77	74 55 08.65	106 38 46	Wynkoop	286 36 39	4863.1	5318.1	3.02
			183 42 55	Newtown	3 43 04	5214.9	5702.8	3.24
Martingale	40 14 35.10	74 56 37.62	252 11 19	Newtown	72 12 26	2562.5	2802.3	1.59
			341 14 55	Attleboro' Academy Cupola	161 15 59	7309.1	7993.0	4.54
Oxford	40 10 21.42	74 53 22.14	165 47 33	Newtown	345 46 33	8878.5	9709.3	5.52
			111 37 55	Attleboro' Academy Cupola	291 36 53	2446.2	2675.1	1.52
Briggs	40 12 22.19	74 53 17.54	154 53 43	Newtown	334 52 40	5143.2	5624.5	3.20
			40 10 10	Attleboro' Academy Cupola	220 09 05	3523.3	3853.0	2.19
Pleasantville	40 09 48.27	74 58 44.83	184 26 14	Wynkoop	4 26 26	5834.5	6380.4	3.63
			250 13 16	Attleboro' Academy Signal	70 15 44	5692.6	6225.3	3.54
Attleboro' Academy, (signal).	40 10 50.68	74 54 58.39	128 27 39	Wynkoop	308 25 25	6261.0	6846.8	3.89
			174 26 30	Watson	354 26 16	2512.6	2747.7	1.56
Churchville	40 11 34.07	75 00 58.93	278 53 05	Attleboro' Academy Signal	98 57 02	8632.6	9440.4	5.36
			315 47 28	Pleasantville	135 48 55	4550.7	4976.5	2.83
Vancleve	40 09 07.75	75 02 42.31	253 50 12	Attleboro' Academy Cupola	73 55 11	11428.5	12497.9	7.10
			208 27 06	Churchville	28 28 13	5133.2	5613.5	3.19
Miles	40 11 14.06	75 02 53.70	257 10 49	Churchville	77 12 03	2784.4	3044.9	1.73
			356 02 29	Vancleve	176 02 36	3904.8	4270.2	2.43

United States Coast Survey.—Geographical Positions. Section II.—New Jersey and Pennsylvania. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Falsington	40 11 50.61	74 48 24.58	293 41 49	Stony Hill	113 50 45	21500.5	23512.3	13.36
			254 42 22	Mount Holly	174 43 17	21819.3	23860.9	13.56
Claybanks	40 07 11.49	74 47 33.41	194 49 30	Trenton Presbyterian Church	14 50 50	11445.3	12516.2	7.11
			143 26 23	Centreville	323 24 46	5771.3	6311.3	3.59
White Hill	40 08 19.49	74 43 33.66	163 00 38	Trenton Presbyterian Church	342 59 23	9376.1	10253.4	5.83
			105 35 47	Centreville	285 31 39	9459.2	10344.3	5.88
Whitehorse	40 11 10.70	74 42 07.51	127 40 06	Trenton Presbyterian Church	307 37 56	6034.1	6598.7	3.75
			46 17 56	Claybanks	226 14 27	10672.9	11671.6	6.63
Bordentown, (Bonaparte's Observatory.)	40 09 17.57	74 42 24.14	62 03 04	Claybanks	241 59 48	8289.2	9064.8	5.15
			94 00 35	Centreville	273 55 42	10782.1	11791.0	6.70
Turkey Hill	40 09 49.10	74 46 09.73	22 10 44	Claybanks	202 09 50	5248.6	5739.7	3.26
			87 38 02	Centreville	267 35 34	5422.6	5930.0	3.37
Bristol, (Kinzey's Hotel)	40 05 37.68	74 51 03.32	221 51 04	Turkey Hill	41 54 13	10413.8	11388.2	6.47
			239 47 10	Claybanks	59 49 25	5752.6	6290.9	3.57
Bordentown, (flag-pole)	40 08 49.95	74 42 29.99	98 36 18	Centreville	278 31 29	10738.2	11743.0	6.67
			67 07 01	Claybanks	247 03 45	7797.5	8527.1	4.84
King	40 01 18.05	74 56 10.10	185 26 35	Stack-house	6 26 32	16120.8	17629.2	10.01
			277 36 55	Mount Holly	99 41 42	13239.1	14477.9	8.23
China College	40 04 45.91	74 53 43.47	171 45 57	Stack-house	351 45 19	9674.3	10579.5	6.01
			28 28 37	King	208 27 03	7291.0	7973.2	4.53
Woodside	40 03 44.52	74 49 14.43	106 34 02	China College	286 31 09	6649.6	7271.8	4.13
			145 57 16	Stack-house	325 53 45	13845.0	15140.5	8.60

United States Coast Survey.—Geographical Positions. Section II.—New Jersey and Pennsylvania. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Belmont	40 08 19.48	74 56 28.85	318 23 56	Mount Holly	138 30 02	20331.0	22233.4	12.63
			358 02 24	King	178 02 36	13004.5	14221.3	8.08
Andalusia	40 04 26.40	74 57 03.15	299 14 49	Mount Holly	119 21 17	16403.0	17937.8	10.19
			347 46 46	King	167 47 20	5943.7	6500.0	3.69
Rosehill	40 04 07.78	74 58 41.08	325 37 29	King	145 39 01	6340.9	6934.2	3.94
			294 04 45	Mount Holly	114 12 22	18220.1	19924.9	11.32
Cowperthwaite	40 03 10.10	74 59 06.88	309 29 28	King	129 31 22	5431.6	5939.8	3.38
			198 57 29	Rosehill	18 57 46	1880.9	2056.9	1.17
Clapier	40 01 09.22	75 09 48.35	201 29 03	Willow Grove	21 31 28	14577.0	15941.0	9.06
			273 18 31	Mount Holly	93 33 11	32515.3	35557.8	20.20
Chestnut Hill, (flag-staff)	40 04 32.94	75 12 08.12	332 11 09	Clapier	152 12 39	7102.8	7767.4	4.41
			229 53 21	Willow Grove	49 57 16	11306.2	12364.1	7.02
Chew	39 48 13.89	75 09 42.28	179 39 18	Clapier	359 39 14	23910.8	26148.1	14.86
			272 39 17	Pine Hill	92 45 57	14902.2	16296.6	9.26
Davis	39 55 36.96	75 17 56.20	228 26 29	Clapier	48 31 43	15459.3	16905.8	9.61
			319 17 28	Chew	139 22 45	18013.4	19698.9	11.19
Vicinity of Philadelphia.								
Girard College	39 58 23.58	75 09 54.09	322 06 55	Pine Hill	142 13 42	24697.6	27008.5	15.34
			264 20 14	Mount Holly	84 34 57	32756.4	35821.4	20.35
Christ Church	39 56 59.66	75 08 20.27	259 10 04	Mount Holly	79 23 47	30923.4	33816.9	19.21
			322 34 55	Pine Hill	142 40 44	21283.7	23280.7	13.23

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
St. Paul's Church, (spire)	39 57 44.56	75 08 11.62	160 01 36	Clapier	340 00 34	6715.6	7344.0	4.17
			116 20 43	Girard College	296 19 37	2712.4	2966.2	1.69
Arch Street Church	39 57 09.46	75 09 06.38	77 16 05	Davis	257 10 24	12896.9	14103.7	8.01
			2 57 34	Chew	182 57 11	16538.7	18086.2	10.28
St. Peter's Church, (Phila.)	39 56 32.23	75 08 33.89	168 19 13	Clapier	348 18 24	8720.8	9536.8	5.42
			150 59 50	Girard College	330 58 58	3924.1	4291.3	2.44
State House Spire, (Phila.)	39 56 52.61	75 08 41.90	321 08 18	Pine Hill	141 14 20	21434.5	23440.1	13.33
			5 07 46	Chew	185 07 07	16061.1	17563.9	6.62
Beck's Shot Tower	39 57 20.38	75 10 12.14	258 48 15	Fishcove	78 52 31	9637.8	10539.6	5.99
			192 23 49	Girard College	12 24 01	1995.4	2182.1	1.24
Eight-square Spire	39 55 45.96	75 08 40.40	160 02 14	Girard College	340 01 27	5128.7	5608.6	3.19
			170 45 13	Clapier	350 44 29	10069.5	11011.7	6.26
Sparks' Shot Tower	39 56 02.18	75 08 28.52	168 41 42	Clapier	348 40 51	9656.0	10559.5	6.00
			155 02 10	Girard College	335 01 15	4809.8	5259.9	2.99
Factory	39 53 37.58	75 08 23.77	156 47 13	Clapier	336 46 19	5088.7	5564.9	3.16
			78 36 57	Girard College	258 35 59	2185.9	2390.4	1.36
Monument Cemetery	39 58 51.24	75 09 08.62	51 39 28	Girard College	231 38 59	1371.8	1500.2	0.85
			167 30 54	Clapier	347 30 28	4358.3	4766.1	2.71
Commissioners' Hall, (Kensington.)	39 58 16.30	75 07 47.16	94 16 19	Girard College	274 14 57	3019.9	3302.5	1.88
			151 40 55	Clapier	331 39 37	6058.1	6225.0	3.76
Wood's Point	39 57 25.27	75 05 19.23	137 16 29	Clapier	317 13 23	9405.2	10285.3	5.84
			105 26 23	Girard College	285 23 39	6765.2	7393.2	4.20

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Fishcove, (Hatchis)	39 58 20.87	75 03 33.67	69 48 15	Christ Church	249 45 01	7247.4	7925.5	4.50
			120 19 34	Clapier	300 15 24	10292.4	11245.5	6.39
Washington Hunter, (1)	40 00 52.51	74 58 48.73	91 56 45	Clapier	271 49 31	15649.6	17113.9	9.72
			73 49 55	Girard College	253 42 58	16436.7	17974.7	10.21
Washington Hunter, (2)	40 00 52.73	74 58 57.20	61 45 49	Christ Church	241 39 46	15169.3	16588.7	9.43
			91 56 35	Clapier	271 49 36	15449.0	16904.6	9.60
Rancocas	40 02 33.10	74 58 20.84	136 19 03	Cowperthwaite	316 18 33	1578.8	1726.5	0.98
			12 02 30	Washington Hunter (1)	192 02 12	3172.4	3469.3	1.97
Morris Hill	39 59 21.78	75 02 17.26	107 15 05	Clapier	287 10 07	11200.3	12248.3	6.96
			80 38 26	Girard College	260 33 40	10985.2	12013.1	6.82
Camden, (church spire)	39 56 41.06	75 07 00.19	154 15 44	Clapier	334 13 56	9182.0	10041.2	5.71
			127 28 27	Girard College	307 26 35	5198.6	5685.0	3.23
Rockwell's House	39 56 37.16	75 12 06.02	223 38 39	Girard College	43 40 04	4536.0	4960.4	2.82
			255 13 00	Fishcove	75 18 29	12573.0	13749.5	7.81
Germantown Spire	40 01 02.16	75 10 48.10	295 43 41	Fishcove	115 48 20	11442.2	12512.8	7.11
			261 15 05	Clapier	81 15 43	1433.2	1567.3	0.89
Lukens	40 06 32.18	75 02 10.30	353 10 57	Pine Hill	173 12 49	34820.7	38078.9	21.63
			298 48 08	Mount Holly	118 57 54	24647.1	26953.3	15.31
Cherry Tree Signal	40 02 41.03	75 07 01.52	328 25 08	Fishcove	148 27 22	9415.7	10296.7	5.85
			10 03 53	Christ Church	190 03 02	10692.3	11692.8	6.64
Bridesburg Foundry, (signal)	40 00 10.16	75 03 27.41	101 26 08	Clapier	281 22 03	9214.9	10077.1	5.73
			70 19 08	Girard College	250 14 59	9742.9	10654.5	6.05

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Bridesburg Arsenal, (flag-staff.)	40 00 26.24	75 03 40.16	66 56 05	Girard College	246 52 05	9642.8	10545.1	5.99
			98 39 50	Clapier	278 35 53	8831.0	9657.3	5.49
George Knowles	40 01 14.68	75 01 34.00	53 30 57	Bridesburg Foundry	233 29 52	3345.7	3658.8	2.08
			16 25 55	Morris' Hill	196 25 27	3631.7	3971.5	2.26
Five Mile Point	39 59 01.43	75 04 10.34	28 53 27	Wood's Point	208 52 29	3386.7	3703.6	2.10
			81 53 25	Girard College	261 49 44	8239.2	9010.1	5.12
Clark	40 00 12.41	75 13 57.97	270 08 41	Mount Holly	90 26 01	38381.6	41972.9	23.85
			317 26 21	Pine Hill	137 35 47	31001.4	33902.2	19.26
Moorestown Spire	39 57 42.27	74 56 42.09	252 08 49	Mount Holly	72 15 03	14511.8	15869.7	9.02
			100 45 44	Clark	280 34 39	25007.7	27347.7	15.54
Evesham	39 56 00.45	74 53 20.81	112 12 18	Clapier	292 01 43	25293.2	27659.9	15.72
			230 00 37	Mount Holly	50 04 42	11798.4	12902.4	7.33
Haddonfield	39 52 50.37	75 02 03.80	237 52 03	Mount Holly	58 01 44	25322.6	27692.0	15.73
			333 40 30	Pine Hill	156 42 17	10051.8	10992.4	6.25
Gibbsboro'	39 50 17.57	74 56 39.88	121 29 57	Haddonfield	301 26 30	9026.4	9871.0	5.61
			217 08 56	Mount Holly	37 15 08	22787.3	24919.5	14.16
Mount Hope	39 52 24.50	75 26 08.66	202 41 53	Yard	22 44 00	11943.4	13060.9	7.42
			288 09 11	Chew	108 19 43	24691.1	27001.3	15.34
Lippencott, (2)	39 43 16.92	75 18 30.21	182 01 36	Davis	2 01 57	22836.4	24973.2	14.19
			233 51 57	Chew	53 57 35	15548.4	17003.3	9.66
Robbins, (2)	39 44 31.29	75 19 42.75	187 00 20	Davis	7 01 28	20684.1	22619.3	12.85
			244 16 19	Chew	64 22 43	15852.5	17335.8	9.85

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Lazaretto, (1)	39 51 33.96	75 17 52.23	11 23 00	Robbins, (2)	191 21 49	13296.8	14541.0	8.26
			297 51 48	Chew	117 57 02	13182.2	14415.7	8.19
Lazaretto Flag-staff	39 51 32.89	75 17 42.70	12 22 09	Robbins, (2)	192 20 53	13311.3	14556.8	8.27
			298 12 18	Chew	118 17 26	12966.8	14180.1	8.06
Leiperville	39 52 22.50	75 19 15.52	2 31 40	Robbins, (2)	182 31 23	14546.9	15908.1	9.04
			299 18 35	Chew	119 24 43	15637.8	17101.0	9.72
Chester Catholic Church	39 51 02.20	75 21 19.52	349 09 01	Robbins, (2)	169 10 03	12275.4	13424.0	7.63
			287 19 19	Chew	107 26 45	17372.4	18998.0	10.79
Thurlow	39 49 38.12	75 22 52.54	243 23 25	Lazaretto, (1)	63 26 37	7983.1	8730.1	4.96
			334 26 25	Robbins, (2)	154 28 27	10488.4	11469.8	6.52
Lamoken	39 50 36.87	75 22 13.66	232 24 36	Leiperville	52 26 30	5342.1	5842.0	3.32
			342 17 36	Robbins, (2)	162 19 13	11835.0	12942.4	7.35
Delaware River..								
Thompson's Point	39 50 31.83	75 18 04.50	91 31 28	Lamoken	271 28 48	5925.3	6479.7	3.68
			153 41 24	Leiperville	333 40 38	3807.5	4163.8	2.37
Man Island	39 50 19.67	75 19 08.59	96 53 34	Lamoken	276 51 36	4431.7	4846.4	2.75
			177 39 33	Leiperville	357 30 29	3791.8	4146.6	2.36
Ridley Creek	39 51 08.81	75 20 05.20	291 39 59	Thompson's Point	111 41 15	3087.5	3376.4	1.92
			207 27 03	Leiperville	27 27 34	2560.9	2800.5	1.59
Opposite Chester	39 49 40.27	75 20 20.24	187 27 28	Ridley Creek	7 27 38	2753.8	3011.5	1.71
			234 29 55	Man Island	54 30 41	2092.4	2288.2	1.30

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	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Crab Creek	39 50 36.40	75 17 20.33	156 52 34	Lazaretto (1)	336 52 14	1930.2	2110.8	1.20
			104 19 25	Ridley Creek	284 17 39	4044.5	4422.9	3.51
Isaac	39 50 44.84	75 15 23.37	84 39 28	Crab Creek	264 38 13	2792.6	3053.9	1.74
			113 11 15	Lazaretto (1)	293 09 39	3848.8	4208.9	2.39
Tinicum	39 51 39.24	75 15 44.45	343 21 57	Isaac	163 22 11	1750.7	1914.5	1.09
			49 37 57	Crab Creek	229 36 56	2991.6	3271.5	1.86
Billingsport	39 51 00.24	75 14 15.88	73 31 22	Isaac	253 30 39	1673.0	1829.5	1.04
			119 44 54	Tinicum	299 43 57	2424.6	2651.5	1.51
Hog Island	39 51 57.79	75 14 00.14	41 20 02	Isaac	221 19 09	2995.7	3276.0	1.86
			77 00 45	Tinicum	256 59 38	2544.2	2782.3	1.58
Mathew	39 51 16.54	75 12 23.33	118 56 45	Hog Island	298 55 43	2629.1	2875.1	1.63
			79 21 53	Billingsport	259 20 41	2722.0	2976.7	1.69
Fort Mifflin	39 52 28.57	75 12 25.13	358 53 49	Mathew	178 53 50	2221.5	2429.4	1.38
			67 12 31	Hog Island	247 11 30	2449.1	2678.3	1.52
Fort Mifflin, (flag-staff)	39 52 28.57	75 12 25.88	358 25 51	Mathew	178 25 53	2222.0	2429.9	1.38
			67 02 37	Hog Island	247 01 37	2432.4	2660.0	1.51
Woodbury Creek	39 51 50.06	75 11 33.29	49 00 49	Mathew	229 00 18	1575.6	1723.0	0.98
			133 57 31	Fort Mifflin	313 56 58	1711.1	1871.2	1.06
South League Island	39 53 06.05	75 11 09.20	13 43 23	Woodbury Creek	193 43 08	2412.4	2638.1	1.50
			57 21 21	Fort Mifflin	237 20 32	2142.4	2342.9	1.33
Red Bank	39 52 23.26	75 10 53.98	164 40 06	South League Island	344 39 56	1368.3	1496.3	0.85
			94 19 53	Fort Mifflin	274 18 55	2172.1	2375.4	1.35

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Red Bank, (flag-staff).......	39 52 17.35	75 11 01.59	99 54 01	Fort Mifflin	279 53 07	2014.9	2203.4	1.25
			46 01 15	Mathew.....................	226 00 21	2699.8	2952.4	1.68
Schuylkill	39 53 32.85	75 11 22.86	338 33 44	South League Island.........	158 33 53	888.0	971.1	0.55
			18 52 26	Mathew.....................	198 51 53	4441.3	4856.9	2.76
Eagle Point	39 52 39.28	75 09 41.21	111 33 43	South League Island.........	291 32 48	2247.4	2457.7	1.40
			85 10 00	Fort Mifflin	265 08 20	3908.3	4274.0	2.43
North League Island	39 53 11.77	75 09 38.35	50 13 17	Red Bank....................	230 12 29	2338.1	2556.9	1.45
			85 19 55	South League Island.........	265 18 56	2165.5	2368.1	1.35
Big Timber Creek...........	39 52 42.68	75 07 45.54	87 49 27	Eagle Point	267 48 12	2750.5	3007.9	1.71
			108 31 04	North League Island.........	288 29 52	2826.6	3091.1	1.76
No. 3........................	39 53 44.62	75 08 27.90	332 12 40	Big Timber Creek............	152 13 07	2159.3	2361.4	1.34
			40 50 27	Eagle Point	220 49 33	2663.4	2912.6	1.66
Gloucester Point............	39 53 46.11	75 07 27.36	88 10 37	No. 3........................	268 09 58	1438.8	1573.4	0.90
			12 26 45	Big Timber Creek............	192 26 33	2003.3	2190.8	1.25
Fish Club, (flag-staff).......	39 53 13.54	75 07 24.32	122 20 46	No. 3........................	302 20 05	1791.8	1959.5	1.11
			28 03 47	Big Timber Creek............	208 03 32	1078.6	1179.5	0.67
Powder Wharf.............	39 54 10.47	75 07 43.73	52 46 35	No. 3........................	232 46 08	1317.8	1441.1	0.82
			332 38 33	Gloucester Point.............	152 38 45	845.9	925.1	0.53
Mickle.......................	39 54 37.24	75 07 02.97	51 11 34	No. 3........................	231 10 40	2588.9	2831.2	1.61
			20 10 30	Gloucester Point.............	200 10 14	1679.8	1837.0	1.04
No. 1........................	39 54 40.81	75 07 51.43	275 26 58	Mickle.......................	95 27 29	1156.0	1264.2	0.72
			348 56 24	Powder Wharf...............	168 56 29	952.7	1041.9	0.59

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	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Kaighn's Point............	39 55 42.89	75 07 33.04	12 51 08	No. 1........................	192 50 56	1963.8	2147.6	1.22
			340 34 27	Mickle........................	160 34 46	2146.7	2347.6	1.33
Navy Yard, (Philadelphia)...	39 55 46.97	75 08 14.52	344 57 21	No. 1........................	164 57 37	2112.7	2310.4	1.31
			277 15 52	Kaighn's Point...............	97 16 19	992.9	1085.8	0.62
Smith's Island............	39 56 17.99	75 07 56.31	332 57 06	Kaighn's Point...............	152 57 21	1215.3	1329.0	0.75
			24 19 02	Navy Yard................	204 18 50	1049.9	1148.1	0.65
Philadelphia Walnut Street Ferry.	39 56 34.08	75 07 27.22	5 00 14	Kaighn's Point...............	185 00 10	1584.5	1732.8	0.99
			54 18 53	Smith's Island...............	234 18 34	850.4	930.0	0.53
Cooper's Point............	39 57 12.58	75 07 22.69	73 40 19	Christ Church...............	253 39 43	1422.3	1555.4	0.88
			5 09 59	Walnut Street Ferry.........	185 09 56	1192.2	1303.8	0.74
Screw Dock...............	39 57 46.92	75 07 36.53	342 46 24	Cooper's Point...............	162 46 33	1108.9	1212.7	0.69
			26 56 00	Market Street...............	206 55 38	1762.9	1927.9	1.10
Richmond.................	39 58 15.62	75 06 39.93	56 36 22	Screw Dock.................	236 35 46	1608.6	1759.1	1.00
			27 34 26	Cooper's Point...............	207 33 59	2193.0	2398.2	1.36
Philadelphia, (Market Street)	39 56 55.96	75 08 10.17	245 32 18	Cooper's Point...............	65 32 49	1238.0	1353.8	0.77
			303 29 34	Walnut Street Ferry.........	123 30 02	1222.7	1337.1	0.76
Delaware River, S. of Chester.								
Chester...................	39 50 33.04	75 21 03.33	231 23 35	Ridley Creek................	51 24 12	1767.9	1933.3	1.10
			278 35 36	Man Island..................	98 36 44	2758.7	3016.8	1.72
Tonkin's Island East.......	39 49 11.40	75 21 40.94	245 07 00	Opposite Chester............	65 07 52	2115.4	2313.4	1.31
			199 33 27	Chester.....................	19 33 51	2671.5	2921.5	1.66

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Tonkin's Island West.......	39 48 48.96	75 22 31.28	161 33 19	Thurlow	341 33 05	1598.5	1748.1	0.99
			239 57 03	Tonkin's Island East	59 57 35	1382.6	1512.0	0.86
Marcus Hook..............	39 48 38.24	75 24 24.97	229 57 40	Thurlow	49 58 39	2871.1	3139.8	1.79
			255 17 54	Tonkin's Island East	75 19 37	4033.0	4410.4	2.51
Opposite Marcus Hook	39 47 39.07	75 24 02.17	163 27 07	Marcus Hook................	343 26 52	1903.9	2082.0	1.18
			204 16 22	Thurlow	24 17 08	4027.7	4404.6	2.50
Naaman's Creek	39 48 02.32	75 26 13.52	246 46 07	Marcus Hook................	66 47 16	2809.5	3072.4	1.75
			282 54 48	Opposite Marcus Hook	102 56 17	3205.8	3505.8	1.99
Old Man Creek............	39 47 01.84	75 25 33.11	208 35 27	Marcus Hook................	28 36 11	3386.5	3703.4	2.10
			242 01 43	Opposite Marcus Hook	62 02 43	2449.5	2678.7	1.52
Lodge	39 47 04.15	75 27 51.56	271 14 17	Old Man Creek	91 15 45	3294.8	3603.1	2.05
			232 25 37	Naaman's Creek	52 26 40	2942.4	3217.7	1.83
Old Man Point............	39 45 37.24	75 27 21.92	165 15 32	Lodge	345 15 13	2771.4	3030.7	1.72
			199 59 00	Naaman's Creek	19 59 44	4760.8	5206.3	2.96
Dupont's Wharf............	39 45 01.98	75 29 17.26	248 21 57	Old Man Point...............	68 23 58	2953.0	3229.3	1.84
			208 24 23	Lodge	28 26 05	4284.4	4685.3	2.66
Penn Grove	39 43 59.74	75 28 19.10	144 11 57	Dupont's Wharf......	324 11 20	2366.7	2588.2	1.47
			204 20 27	Old Man Point...............	24 21 54	3301.2	3610.1	2.05
Christine Light-house, or Wilmington Light-house.	39 43 15.25	75 30 55.69	249 47 11	Penn Grove	69 48 52	3973.2	4345.0	2.47
			215 26 39	Dupont's Wharf......	35 27 42	4040.5	4418.6	2.51
Quarry Wharf	39 46 16.71	75 28 21.68	359 09 45	Penn Grove	179 09 47	4224.6	4619.9	2.62
			29 51 13	Dupont's Wharf......	209 50 38	2657.3	2905.9	1.65

United States Coast Survey.—Geographical Positions. Section II.—New Jersey and Delaware. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Black Horse	39 54 45.42	75 25 06.62	298 42 41	Chew	118 52 33	25068.6	27414.3	15.58
			336 01 26	Lippencott (2)	156 05 40	23231.5	25405.3	14.44
West	39 45 36.73	75 12 00.61	132 13 48	Black Horse	312 05 24	25210.0	27568.9	15.66
			214 10 04	Chew	34 11 33	5858.6	6406.8	3.64
Caffery	39 47 28.44	75 12 59.73	128 01 01	Black Horse	307 53 15	21912.1	23962.4	13.61
			253 21 58	Chew	73 24 05	4901.4	5360.0	3.05
Acton	39 38 08.61	75 22 45.32	169 37 36	Mount Hope	349 35 26	26834.8	29345.7	16.67
			212 34 12	Lippencott (2)	32 36 55	11284.9	12340.8	7.01
Grand View	39 42 39.49	75 42 03.43	286 44 24	Acton	106 56 44	28837.5	31535.8	17.92
			305 44 50	Burden	125 57 17	34426.5	37647.8	21.39
Wilmington	39 44 55.82	75 33 35.61	308 58 05	Acton	129 05 00	19943.1	21852.9	12.42
			70 53 09	Grand View	250 47 44	12802.3	14000.2	7.95
Shellpot	39 45 57.52	75 30 00.89	324 17 57	Acton	144 22 35	17797.9	19463.2	11.06
			71 16 44	Meeting-house Hill	251 08 37	18608.6	20349.8	11.56
Iron Hill	39 38 17.28	75 44 48.40	350 58 54	Buck (2)	170 59 40	11044.2	12077.6	6.86
			76 57 39	Principio	256 47 59	22257.5	24340.1	13.83
Barker	39 26 16.76	75 21 45.94	124 04 05	Iron Hill	303 49 25	39793.3	43516.8	24.73
			173 37 25	Burden	353 36 56	10209.6	11164.9	6.34
Fort Delaware	39 35 18.79	75 33 49.20	109 21 06	Iron Hill	289 14 05	16658.9	18217.7	10.35
			139 07 22	Grand View	319 01 58	17986.5	19669.5	11.18
Swedesboro' Spire	39 44 58.94	75 18 07.32	180 46 08	Davis	0 46 15	19677.6	21518.8	12.23
			243 22 42	Chew	63 28 06	13437.5	14694.9	8.35

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Scull, (1)	39 43 30.01	75 20 22.73	93 02 59	Wilmington	277 54 32	19061.8	20845.4	11.84
			108 20 27	Shellpot	288 14 17	14495.8	15852.2	9.01
Allen	39 41 14.14	75 22 28.26	4 03 53	Acton	184 03 42	5735.6	6272.5	3.57
			113 20 00	Wilmington	293 12 53	17301.3	18920.2	10.75
Scull, (2)	39 40 56.57	75 20 32.89	31 22 02	Acton	211 20 37	6065.3	6632.8	3.77
			101 09 28	Allen	281 08 15	2801.5	3063.6	1.74
Big Mannington Hill	39 36 54.09	75 21 21.79	139 05 27	Acton	319 04 33	3041.1	2325.7	1.89
			168 49 43	Allen	348 49 00	8174.3	8939.2	5.08
Reeves	39 39 03.38	75 22 46.20	125 08 51	Wilmington	305 01 56	18906.4	20675.5	11.75
			141 00 22	Shellpot	320 55 44	16441.4	17979.8	10.22
Ellet	39 38 19.55	75 23 37.05	130 38 51	Wilmington	310 32 29	18780.0	20537.3	11.67
			147 06 48	Shellpot	327 02 43	16824.9	18399.2	10.45
Sawyer	39 42 02.84	75 33 29.56	95 28 12	Grandview	275 22 44	12296.0	13446.5	7.54
			178 28 06	Wilmington	358 28 02	5366.0	5868.1	3.33
Baar	39 40 45.33	75 35 01.35	109 20 32	Grandview	289 16 02	10655.8	11652.9	6.62
			194 48 01	Wilmington	14 48 56	7989.7	8737.3	4.96
New Castle, (spire of Episcopal church.)	39 39 35.71	75 33 27.34	114 48 33	Grandview	294 43 04	13538.8	14805.6	8.41
			178 52 54	Wilmington	358 52 49	9874.6	10798.6	6.14
Chestnut Hill	39 39 00.45	75 45 51 27	218 45 41	Grandview	38 48 06	8667.5	9478.5	5.39
			237 55 06	Wilmington	58 02 56	20669.9	12604.0	12.84
Salem Spire	39 34 25.42	75 27 37.98	108 06 41	Chestnut Hill	287 55 04	27422.5	29988.4	17.04
			126 31 12	Grandview	306 22 00	25650.9	28051.0	15.93

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
McMullen	39 37 36.87	75 37 47.22	102 37 36	Chestnut Hill	282 32 27	11825.5	12932.0	7.35
			146 49 37	Grandview	326 46 53	11153.2	12196.8	6.93
Gray's Hill	39 36 44.50	75 47 32.43	233 48 08	Iron Hill	53 49 52	4846.8	5300.3	3.01
			324 55 51	Buck, (2)	144 58 13	9829.4	10749.1	6.11
Riggs' Hill	39 35 30.27	75 54 23.28	249 21 32	Iron Hill	69 27 38	14646.7	16017.2	9.10
			289 26 50	Buck, (2)	109 33 51	16488.8	18031.7	10.25
Gravelly Hill	39 38 35.02	75 57 31.38	271 39 03	Iron Hill	91 47 11	18199.4	19902.3	11.31
			321 45 44	Riggs' Hill	141 47 44	7251.7	7930.2	4.51
Bohemia Manor	39 28 46.70	75 46 24.61	137 28 23	Riggs' Hill	317 23 18	16892.0	18472.6	10.50
			173 44 20	Gray's Hill	353 43 37	14818.3	16204.9	9.21
Ash	39 38 02.71	75 47 12.60	65 26 48	Riggs' Hill	245 22 13	11297.2	12354.3	7.02
			93 54 58	Gravelly Hill	273 48 23	14787.5	16171.2	9.19
Head of Christine	39 41 44.37	75 47 20.85	1 42 36	Gray's Hill	181 42 29	9251.4	10117.1	5.74
			41 09 15	Riggs' Hill	221 04 45	15313.7	16746.6	9.52
Shickerville	39 43 52.24	75 47 08.25	342 06 12	Iron Hill	162 07 41	10853.6	11869.2	6.74
			2 30 04	Gray's Hill	182 29 49	13203.3	14438.2	8.20
Missimer	39 44 56.00	75 47 44.46	341 08 47	Iron Hill	161 10 39	12991.4	14207.0	8.07
			297 22 02	Grandview	117 25 40	9147.0	10002.9	5.68
Maulden's Mountain	39 29 12.01	75 59 07.83	255 03 38	Buck, (2)	75 13 27	23030.2	25185.1	14.31
			174 16 38	Principio	354 16 06	11822.6	12928.9	7.35
Egg Hill	39 39 30.21	75 53 41.21	50 52 53	Principio	230 48 53	11563.4	12645.4	7.18
			22 15 49	Maulden's Mountain	202 12 21	20595.8	22523.0	12.80

United States Coast Survey.—Geographical Positions. Section II.—New Jersey and Delaware. Sketch B, No. 3.

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Buck, (1)	39 32 29.31	75 43 23.39	169 18 05	Iron Hill	349 17 11	10920.5	11942.3	6.79
			74 59 13	Maulden's Mountain	254 49 12	23364.6	25550.8	14.52
Church Landing Point	39 39 36.75	75 31 00.87	89 28 06	New Castle Spire	269 26 32	3495.4	3822.5	2.17
			159 28 40	Wilmington	339 27 01	10507.1	11490.3	6.53
Wilmington Town Hall	39 44 26.56	75 32 42.43	344 51 03	Church Landing Point	164 51 38	9259.4	10125.8	5.75
			125 29 00	Wilmington	305 28 26	1554.0	1699.4	0.97
Kimsey	39 38 03.11	75 33 02.74	225 11 27	Church Landing Point	45 12 45	4100.1	4483.8	2.55
			168 23 46	New Castle Spire	348 23 30	2915.3	3188.1	1.81
Great Creek	39 38 33.02	75 35 17.56	286 00 10	Kimsey	106 01 36	3344.2	3657.1	2.08
			233 38 45	New Castle Spire	53 39 55	3261.9	3567.1	2.03
Red Lion	39 35 50.40	75 36 24.25	229 35 25	Kimsey	49 37 34	6310.3	6900.7	3.92
			197 36 05	Great Creek	17 36 48	5258.1	5750.1	3.27
Finn's Point	39 35 58.11	75 32 45 92	12 13 38	Port Penn	192 12 48	8862.7	9692.0	5.51
			347 35 41	Elsinborough Point	167 36 20	6832.1	7471.4	4.25
Delaware City Spire	39 34 38.14	75 35 17.59	144 29 21	Red Lion	324 28 38	2737.8	2994.0	1.70
			235 45 34	Finn's Point	55 47 10	4386.7	4797.2	2.73
Penn's Neck	39 35 38.05	75 32 16.88	132 10 36	Finn's Point	312 10 17	923.7	1010.1	0.57
			93 43 01	Red Lion	273 40 23	5913.7	6467.1	3.68
Reedy Point	39 33 47.41	75 33 44.89	199 14 39	Finn's Point	19 15 16	4270.5	4670.1	2.65
			312 33 59	Elsinborough Point	132 35 15	3905.1	4270.5	2.43
Bombay Hook	39 18 48.79	75 26 05.49	217 34 50	Pine Mount	37 38 44	14472.7	15826.9	8.99
			340 14 07	Deep Water	160 16 09	13676.7	14956.4	8.50

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Liston	39 25 00.06	75 32 34.55	269 53 00	Pine Mount	90 01 01	18132.2	19828.8	11.27
			320 50 28	Bombay Hook	140 54 35	14758.0	16138.9	9.17
Round Island	39 25 18.79	75 27 13.74	85 43 29	Liston	265 40 05	7694.4	8414.4	4.78
			352 15 34	Bombay Hook	172 16 17	12136.9	13272.6	7.54
Stony Point	39 27 29.89	75 30 49.85	28 27 85	Liston	208 26 29	5255.0	5746.7	3.27
			308 01 11	Round Island	128 03 28	6561.0	7174.9	4.08
Appoquinimink	39 27 54.73	75 35 10.18	276 59 27	Stony Point	97 02 12	6269.7	6856.4	3.90
			325 20 56	Liston	145 22 35	6546.7	7159.3	4.07
Port Penn	39 31 17.20	75 34 04.55	326 24 41	Stony Point	146 26 45	8412.7	9199.9	5.23
			14 06 14	Appoquinimink	194 05 33	6437.7	7040.1	4.00
Alloway's Point	39 30 04.77	75 31 30.83	121 19 44	Port Penn	301 18 06	4297.8	4700.0	2.67
			52 36 04	Appoquinimink	232 33 45	6599.6	7217.1	4.10
Elsinborough Point	39 32 21.74	75 31 44.41	355 36 25	Alloway's Point	175 36 34	4236.3	4632.7	2.63
			59 16 19	Port Penn	239 14 50	3893.4	4257.7	2.42
St. George's Creek	39 33 01.74	75 33 46.15	292 59 19	Elsinborough Point	113 00 36	3157.3	3452.7	1.96
			7 45 44	Port Penn	187 45 32	3253.5	3557.9	2.02
Reedy Island Light-house	39 30 00.15	75 33 49.41	171 20 56	Port Penn	351 20 46	2402.7	2627.5	1.49
			267 31 51	Alloway's Point	87 33 19	3314.0	3624.1	2.06
Barney's House	39 27 28.11	75 34 51.67	151 47 01	Appoquiniminink	331 46 49	934.7	1022.2	0.58
			269 24 14	Stony Point	89 26 48	5781.4	6322.4	3.59
Blackbird's Creek	39 26 42.27	75 34 05.47	325 23 29	Liston	145 24 27	3829.0	4187.3	2.38
			252 32 41	Stony Point	72 37 45	4902.2	5360.9	3.05

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Collins	39 23 44.87	75 31 17.88	141 39 51	Liston	321 39 02	2956.6	3233.3	1.84
			251 02 57	Barker	71 09 00	14459.5	15812.5	8.98
DELAWARE BAY.								
Bombay Hook North	39 21 17.20	75 29 46.01	149 36 21	Liston	329 34 34	7968.3	8713.9	4.95
			231 09 03	Barker	51 14 08	14739.2	16118.4	9.16
Bombay Hook Light-house	39 21 46.22	75 30 18.92	312 01 01	Bombay Hook	132 03 42	8170.9	8935.5	5.08
			214 02 25	Round Island	34 04 23	7912.0	8652.3	4.92
Arnold	39 23 14 78	75 25 40.49	4 10 34	Bombay Hook	184 10 18	8224.4	8994.0	5.11
			108 10 57	Liston	288 06 34	10424.5	11399.9	6 48
Liston's Point	39 25 00.47	75 31 59.48	89 12 16	Liston	269 11 54	838.8	917.3	0.52
			323 29 31	Bombay Hook	143 33 16	14252.9	15596.5	8.86
Ben Davis	39 17 12.09	75 17 09.57	103 07 13	Bombay Hook	283 01 34	13181.2	14414.6	8.19
			164 33 20	Pine Mount	344 31 34	14988.5	16391.0	9.31
Egg Island Light-house	39 10 30.89	75 08 01.74	96 41 41	Deep Water	276 32 18	21524.6	23538.7	13.37
			179 50 22	Joseelyne	359 50 21	14989.8	16392.4	9.31
Egg Island Point	39 10 23.53	75 07 49.00	133 11 21	Ben Davis	313 05 27	18423.7	20147.6	11.45
			97 11 29	Deep Water	277 02 08	21855.0	23900.0	13.58
Big Island	39 19 45.61	75 18 14.08	81 13 10	Bombay Hook	261 08 11	11425.9	12495.0	7.10
			341 54 38	Ben Davis	161 55 28	4979.2	5445.1	3.11
Dunk's Beach	39 20 32.91	75 21 50.90	198 20 46	Pine Mount	18 21 56	8696.4	9510.1	5.40
			285 40 16	Big Island	105 42 31	5392.9	5897.5	3.35

United States Coast Survey.—Geographical Positions. Section II.—Delaware Bay. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Goose Point	39 15 05.87	75 23 36.30	195 59 52	Pine Mount	16 02 11	19079.2	20864.4	11.86
			247 11 19	Ben Davis	67 15 24	10053.2	10993.9	6.25
Bush Hill	39 23 56.56	75 15 23.71	106 51 25	Pine Mount	286 48 32	6816.3	7254.1	4.24
			55 54 41	Dunks' Beach	235 50 27	11194.3	12241.8	6.96
Harris	39 25 06.89	75 17 16.25	37 54 16	Dunks' Beach	217 51 22	10704.1	11705.7	6.65
			308 50 38	Bush Hill	128 51 58	3456.9	3780.4	2.15
Wheaton	39 23 26.60	75 19 05.89	220 17 27	Harris	40 18 37	4055.1	4434.5	2.52
			157 20 47	Pine Mount	337 20 15	3140.1	3433.9	1.95
Hann, No. 2	39 25 24.01	75 15 07.01	8 25 41	Bush Hill	188 25 34	2725.8	2980.9	1.69
			80 19 19	Harris	260 17 52	3135.5	3428.9	1.95
Garrison	39 23 33.66	75 13 02.91	101 51 21	Bush Hill	281 49 52	3441.9	3763.9	2.14
			138 54 32	Hann, No. 2	318 53 13	4515.6	4938.1	2.81
Buck	39 25 07.50	75 13 16.99	100 57 37	Hann, No. 2	280 56 27	2680.0	2930.8	1.67
			353 21 35	Garrison	173 21 43	2913.2	3185.8	1.81
Mount Pleasant	39 23 21.96	75 15 02.76	135 23 30	Harris	315 21 55	4546.2	4971.6	2.83
			178 27 04	Hann, No. 2	358 27 01	3764.9	4117.2	2.34
Hensted, No. 2	39 22 55.14	75 18 38.64	205 52 23	Harris	25 53 15	4515.6	4938.1	2.81
			154 18 13	Pine Mount	334 17 24	4292.6	4694.3	2.67
Dayre	39 21 44.55	75 19 53.57	326 59 13	Big Island	147 00 16	4373.3	4782.5	2.72
			51 49 29	Dunks' Beach	231 48 15	3573.5	3907.9	2.22
Sheppard	39 22 38.22	75 21 03.34	16 25 12	Dunks' Beach	196 24 42	4028.3	4405.2	2.50
			314 44 11	Dayre	134 44 55	2351.0	2571.0	1.46

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	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Greenwich	39 23 24.39	75 20 21.71	347 39 35	Dayre	167 39 53	3151.5	3446.4	1.96
			34 59 02	Sheppard	214 58 35	1737.6	1900.2	1.08
Davis	39 22 37.32	75 20 11.84	91 16 56	Sheppard	271 16 25	1232.9	1348.3	0.77
			170 45 18	Greenwich	350 45 12	1470.4	1608.0	0.91
Cohansey Light-house	39 20 18.39	75 21 17.48	192 33 20	Pine Mount	12 34 10	8914.9	9749.0	5.54
			68 11 42	Bombay Hook	248 08 39	7430.6	8125.9	4.62
Thumbcap	39 16 27.41	75 24 43.13	155 38 55	Bombay Hook	335 38 03	4784.9	5232.6	2.97
			208 34 28	Dunks' Beach	28 36 17	8621.3	9428.0	5.36
Fortesque	39 14 09.39	75 09 59.99	118 43 13	Ben Davis	298 38 41	11738.1	12836.4	7.29
			77 07 58	Deep Water	256 59 49	19018.1	20797.6	11.82
Flax Farm	39 16 33.25	75 12 54.39	101 06 12	Ben Davis	281 03 24	6232.0	6815.1	3.87
			316 40 49	Fortesque	136 42 45	6095.3	6665.6	3.79
Eagle Island	39 17 46.00	75 14 07.56	76 32 12	Ben Davis	256 30 28	4484.6	4904.2	2.79
			122 00 33	Big Island	301 57 46	6962.0	7613.4	4.33
Nantuxent	39 16 33.54	75 14 25.95	106 52 48	Ben Davis	286 51 04	4097.3	4480.7	2.55
			191 09 26	Eagle Island	11 09 36	2276.9	2490.0	1.42
West Point	39 19 03.05	75 15 10.69	39 47 11	Ben Davis	219 45 56	4451.5	4868.0	2.77
			106 38 48	Big Island	286 36 52	4584.0	5012.9	2.85
East Point	39 11 28.35	75 00 58.06	110 57 14	Fortesque	290 51 31	13915.6	15217.7	8.65
			78 34 44	Egg Island Point	258 30 24	10062.5	11004.1	6.25
Egg Island Point, (2)	39 10 21.79	75 07 45.94	97 18 37	Deep Water	277 09 04	21935.4	23987.9	13.63
			133 09 19	Ben Davis	313 03 23	18514.2	20246.6	11.50

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Clark's Point	39 01 20.17	75 20 13.02	227 00 00	Egg Island Point, (2)	47 07 51	24517.8	26811.9	15.23
			168 51 44	Deep Water	348 50 02	19836.0	21692.1	12.32
Port Norris	39 14 33.03	75 00 57.47	0 08 34	East Point	180 08 34	5694.6	6227.4	3.54
			52 06 28	Egg Island Point	232 02 08	12516.3	13687.5	7.78
Dividing Creek	39 15 16.96	75 05 04.11	73 39 31	Fortesque	253 36 24	7394.0	8085.9	4.59
			23 37 38	Egg Island Point	203 35 54	9874.8	10798.8	6.14
Turkey Point	39 14 55.97	75 07 21.46	69 18 45	Fortesque	249 17 05	4063.6	4443.8	2.53
			4 30 01	Egg Island Point	184 29 44	8426.9	9215.4	5.24
Muddy Creek	38 58 58.86	75 18 28.29	216 11 23	Egg Island Point, (2)	36 18 08	26111.0	28554.2	16.22
			165 05 10	Deep Water	345 02 23	24652.0	26958.7	15.32
Town Bank	38 58 36.94	74 57 21.96	145 26 52	Egg Island Point, (2)	325 20 19	26405.9	28876.7	16.41
			91 22 50	Muddy Creek	271 09 33	30484.0	33336.4	18.94
Cape Henlopen	38 46 45.11	75 04 44.55	138 48 18	Muddy Creek	318 39 41	30099.4	32915.8	18.70
			205 52 52	Town Bank	25 57 30	24403.5	26686.9	15.16
Cape Henlopen Light-house	38 46 38.35	75 04 43.24	205 36 11	Town Bank	25 40 48	24579.1	26879.0	15.27
			139 01 11	Muddy Creek	318 52 33	30277.2	33110.2	18.81
Plumb Point	38 50 11.33	75 12 59.40	297 59 51	Cape Henlopen	118 05 01	13525.4	14797.4	8.40
			235 18 04	Town Bank	55 27 54	27442.7	30010.2	17.05
Pilot Town	38 47 07.50	75 09 12.08	276 04 54	Cape Henlopen	96 07 39	6493.0	7100.5	4.03
			135 57 58	Plumb Point	315 55 38	7886.4	8624.3	4.90
Breakwater Light-house	38 47 53.64	75 06 08.58	316 10 38	Cape Henlopen	136 11 31	2928.7	3202.7	1.82
			212 33 53	Town Bank	32 39 24	23547.7	25751.1	14.63

United States Coast Survey.—Geographical Positions. Section II.—Delaware Bay. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Cape Henlopen Beacon	38 47 25.07	75 04 49.77	354 09 59	Cape Henlopen	174 10 02	1238.7	1354.6	0.77
			85 07 51	Pilot Town	265 05 07	6352.9	6947.3	3.95
Ice-breaker West	38 47 58.44	75 06 41.79	308 37 26	Cape Henlopen	128 38 40	3621.6	3960.5	2.25
			66 35 40	Pilot Town	246 34 06	3951.9	4321.7	2.46
Bowers	39 03 42.04	75 23 28.20	241 20 38	Egg Island Point, (2)	61 30 33	25772.4	28184.0	16.01
			320 24 47	Muddy Creek	140 27 57	11325.9	12385.7	7.04
Kitt's Hammock	39 06 04.35	75 23 46.82	250 55 52	Egg Island Point, (2)	71 05 59	24401.6	26684.9	15.16
			186 54 59	Deep Water	6 55 33	10777.5	11786.0	6.70
Little Creek	39 09 21.90	75 24 03.86	200 19 31	Deep Water	20 20 16	4913.6	5373.4	3.05
			265 24 58	Egg Island Point, (2)	85 35 16	23546.9	25750.2	14.63
Mahon's River Light-house	39 10 16.40	75 23 43.43	269 30 04	Egg Island Point, (2)	89 40 09	22981.9	25132.3	14.28
			340 02 43	Muddy Creek	160 06 03	22222.3	24301.6	13.81
West Creek	39 10 27.02	74 54 44.79	89 34 35	Egg Island Point, (2)	269 26 22	18749.1	20503.5	11.65
			9 48 09	Town Bank	189 46 30	22218.4	24297.4	13.80
Bird Island	39 11 44.34	75 01 09.96	347 15 49	Town Bank	167 18 12	24889.8	27218.7	15.47
			284 25 50	West Creek	104 29 53	9545.4	10438.6	5.93
Elder Point	39 12 39.59	75 02 32.32	213 01 28	Port Norris	33 02 28	4172.2	4562.6	2.59
			310 45 34	Bird Island	130 46 26	2608.9	2853.0	1.62
Tomlin	39 13 43.58	74 59 49.96	133 17 17	Port Norris	313 16 34	2224.2	2432.3	1.38
			27 33 58	Bird Island	207 33 07	4147.2	4535.3	2.58
Wiggins	39 14 33.23	74 59 47.70	89 47 33	Port Norris	269 46 49	1673.4	1830.0	1.04
			20 45 23	Bird Island	200 44 31	5569.0	6090.1	5.46

United States Coast Survey.—Geographical Positions. Section II.—Delaware Bay. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Oranoken	39 12 04.47	75 06 24.62	31 39 04	Egg Island Point, (2)	211 38 13	3719.0	4067.0	2.31
			274 40 16	Bird Island	94 43 35	7575.0	8283.8	4.71
Pierce's Landing	39 04 54.33	74 54 05.78	117 12 42	Egg Island Point, (2)	297 04 06	22134.8	24025.9	13.75
			174 47 06	West Creek	354 46 41	10301.0	11264.9	6.40
Goshen	39 07 36.35	74 53 10.93	156 49 40	West Creek	336 48 41	5724.7	6260.4	3.56
			103 43 34	Egg Island Point, (2)	283 34 21	21618.7	23641.6	13.43
Fishing Creek	39 01 04.08	74 56 32.26	136 47 36	Egg Island Point, (2)	316 40 31	23617.1	25826.9	14.67
			188 27 08	West Creek	8 28 16	17549.6	19191.7	10.90
Robinson	39 11 23.73	74 59 22.90	327 35 14	Pierce's Landing	147 38 36	14218.2	15548.6	8.83
			284 39 34	West Creek	104 42 26	6899.4	7545.0	4.29
Carlisle	39 12 03.25	74 56 48.15	315 03 35	West Creek	135 04 53	4191.5	4583.7	2.60
			71 50 37	Robinson	251 48 59	3907.8	4273.5	2.43
Ludlum's Landing	39 10 38.46	74 50 50.00	86 26 15	West Creek	266 33 47	5646.2	6174.5	3.51
			31 04 53	Goshen	211 03 24	6556.3	7169.8	4.07
McCrea	39 09 49.32	74 50 26.09	100 37 35	West Creek	280 34 52	6317.6	6909.4	3.93
			159 15 31	Ludlum's Landing	339 15 16	1620.4	1772.0	1.01
Stipson	39 11 51.41	74 54 18.31	13 43 16	West Creek	193 42 59	2678.9	2929.6	1.67
			304 01 32	McCrea	124 03 58	6726.0	7355.4	4.18
Mispilion Light-house	38 56 38.00	75 18 29.37	180 20 34	Muddy Creek	00 20 35	4343.4	4749.8	2.70
			312 31 21	Cape Henlopen	132 39 59	27010.4	29537.8	16.78
Doctor's Island	38 54 33.09	75 17 45.67	307 23 16	Cape Henlopen	127 31 26	23726.8	25946.9	14.74
			172 51 52	Muddy Creek	352 51 25	8258.7	9031.5	5.13

United States Coast Survey.—Geographical Positions. Section II.—Delaware Bay. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Hog Island	38 53 29.92	75 16 25.17	306 23 39	Cape Henlopen	126 30 58	21006.3	22971.9	13.05
			163 42 52	Muddy Creek	343 41 35	10566.8	11555.5	6.57
Potter	38 56 40.68	75 20 41.75	217 00 20	Muddy Creek	37 01 44	5336.2	5835.5	3.32
			271 28 25	Mispilion Light-house	91 29 48	3188.6	3487.0	1.98
Primrose	38 58 12.75	75 20 11.44	240 11 36	Muddy Creek	60 12 41	2860.6	3128.3	1.78
			14 25 12	Potter	194 24 53	2924.7	3198.4	1.82
Gerdes' Camp	38 56 05.97	75 18 39.64	182 56 05	Muddy Creek	2 56 12	5337.9	5837.4	3.32
			150 31 32	Primrose	330 30 34	4490.8	4911.0	2.79
Carpenter	38 56 02.91	75 19 50.08	199 56 28	Muddy Creek	19 57 19	5771.5	6311.5	3.59
			266 48 44	Gerdes' Camp	86 49 28	1698.8	1857.8	1.06
Slaughter Creek	38 51 48.15	75 14 35.09	303 12 46	Cape Henlopen	123 18 56	17035.2	18629.2	10.58
			322 17 23	Plumb Point	142 18 24	3774.2	4127.4	2.35
Fisher	38 47 35.81	75 12 19.81	278 03 34	Cape Henlopen	98 08 19	11096.8	12135.1	6.89
			168 44 27	Plumb Point	348 44 02	4889.1	5346.1	3.04
Lewes Entrance	38 48 48.24	75 11 32.41	291 03 43	Cape Henlopen	111 07 53	10548.0	11535.0	6.55
			27 07 07	Fisher	207 06 42	2508.8	2743.6	1.56
Hazard	38 48 45.22	75 12 29.88	288 12 51	Cape Henlopen	108 17 43	11822.7	12929.0	7.35
			164 59 37	Plumb Point	344 59 18	2748.5	3005.7	1.71
Lewes Spire	38 46 28.28	75 08 08.27	263 57 37	Cape Henlopen	83 59 45	4944.0	5406.6	3.07
			131 14 20	Lewes Entrance	311 12 12	6548.6	7161.4	4.07
Holsten	38 49 16.33	75 13 55.04	289 17 48	Cape Henlopen	109 23 33	14076.4	15393.5	8.75
			218 21 29	Plumb Point	38 22 04	2162.4	2364.7	1.34

United States Coast Survey.—Geographical Positions. Section II.—Coast of New Jersey. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Big Tree	38 45 44.63	75 11 05.60	219 44 46	Town Bank	39 53 23	31003.3	33904.3	19.26
			258 30 25	Cape Henlopen	78 34 24	9384.5	10262.6	5.83
Cape May Old Light-house	38 55 48.64	74 57 38.90	101 08 35	Muddy Creek	280 55 27	30646.1	33513.6	19.04
			151 35 26	Egg Island Point, (2)	331 29 03	30625.2	33490.8	19.03
COAST OF NEW JERSEY.								
From Cape May to Great Egg Harbor.								
Two-mile Beach	38 57 26.13	74 50 40.10	102 45 16	Town Bank	282 41 03	9916.7	10844.6	6.16
			45 54 58	Cape Henlopen	225 46 08	28372.4	31027.2	17.63
Congress Hall	38 55 51.01	74 55 09.77	148 07 42	Town Bank	328 06 19	6024.9	6588.6	3.74
			245 40 09	Two-mile Beach	65 43 00	7125.2	7791.9	4.43
Higbee	38 57 14.12	74 57 31.95	185 22 18	Town Bank	5 22 24	2565.2	2805.2	1.59
			306 48 11	Congress Hall	126 49 40	4276.1	4676.2	2.66
Cape May New Light-house	38 55 50.42	74 57 15.57	178 16 42	Town Bank	358 16 38	5137.6	5618.3	3.19
			269 38 30	Congress Hall	89 39 49	3029.5	3313.0	1.88
Week's Landing	38 58 55.59	74 52 49.60	30 40 36	Congress Hall	210 39 08	6615.7	7234.7	4.11
			311 29 00	Two-mile Beach	131 30 21	4162.5	4552.0	2.59
Leaming's Point	39 00 56.64	74 50 58.48	32 42 52	Congress Hall	212 40 14	11197.8	12245.6	6.96
			356 05 56	Two-mile Beach	176 06 08	6506.0	7114.8	4.84
Nummy's Island	39 01 39.50	74 47 09.31	76 32 18	Leaming's Point	256 29 54	5668.4	6198.8	3.52
			33 00 42	Two-mile Beach	212 58 29	9314.5	10186.1	5.79

United States Coast Survey.—Geographical Positions. Section II.—Coast of New Jersey. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Crese	39 03 00.05	74 49 28.91	29 31 15	Leaming's Point	209 30 19	4372.6	4781.7	2.72
			306 29 00	Nummy's Island	126 30 28	4175.9	4566.6	2.59
Cyrus	39 04 28.55	74 44 01.20	70 55 22	Crese	250 51 57	8336.7	9116.8	5.18
			40 57 48	Nummy's Island	220 55 49	6901.2	7546.9	4.29
Eldridge	39 06 03.41	74 47 17.07	358 41 07	Nummy's Island	178 41 12	8139.8	8901.4	5.06
			301 50 28	Cyrus	121 52 31	5541.9	6060.5	3.44
Holmes	39 07 32.71	74 45 53.73	36 01 43	Eldridge	216 00 50	3404.9	3723.5	2.12
			334 31 48	Cyrus	154 32 59	6289.6	6878.1	3.91
Leaming's Beach North	39 06 26.06	74 42 12.54	84 34 29	Eldridge	264 31 17	7349.9	8037.7	4.57
			35 47 04	Cyrus	215 45 53	4466.7	4884.6	2.78
Townsend	39 10 23.84	74 43 09.98	349 20 29	Leaming's Beach North	169 21 05	7460.6	8158.7	4.64
			36 42 06	Holmes	216 40 23	6580.4	7196.1	4.09
Ludlam's Beach	39 08 41.50	74 41 29.69	71 31 38	Holmes	251 28 51	6686.0	7311.6	4.15
			142 40 13	Townsend	322 39 10	3969.4	4340.8	2.47
Corson	39 13 41.40	74 40 35.77	7 58 13	Ludlam's Beach	187 57 39	9337.7	10211.4	5.80
			31 17 11	Townsend	211 15 34	7127.2	7794.1	4.44
Mountain Creek	39 11 42.80	74 38 51.74	68 34 28	Townsend	248 31 45	6658.2	7281.2	4.14
			34 09 24	Ludlam's Beach	214 07 44	6754.8	7386.9	4.20
Weakfish Creek	39 13 28.80	74 37 38.73	95 14 46	Corson	275 12 54	4263.8	4662.8	2.65
			28 11 36	Mountain Creek	208 10 50	3708.1	4055.1	2.30
Blackman	39 15 04.74	74 39 13.93	37 22 27	Corson	217 21 35	3233.4	3535.9	2.01
			322 20 11	Weakfish Creek	142 21 11	3736.9	4086.6	2.32

United States Coast Survey.—Geographical Positions. Section II.—Coast of New Jersey. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Beasley's Point	39 16 46.91	74 37 21.48	3 52 21	Weakfish Creek	183 52 10	6123.0	6695.9	3.80
			40 33 23	Blackman	220 32 12	4146.1	4534.1	2.58
Peck's Beach	39 16 11.77	74 34 51.52	38 35 43	Weakfish Creek	218 33 57	6428.6	7030.1	3.99
			71 49 56	Blackman	251 47 10	6621.2	7240.7	4.11
Somers' Point	39 18 38.78	74 35 02.95	356 32 32	Peck's Beach	176 32 39	4541.3	4966.2	2.82
			43 54 34	Beasley's Point	223 53 08	4786.9	5234.8	2.97
New Inlet	39 19 08.49	74 30 30.65	48 56 30	Peck's Beach	228 53 45	8292.4	9068.3	5.15
			82 01 45	Somers' Point	261 58 52	6586.3	7202.6	4.09
Risley's Landing	39 22 48.75	74 31 11.49	35 44 07	Somers' Point	215 41 40	9493.6	10382.0	5.90
			351 48 18	New Inlet	171 48 44	6862.1	7504.2	4.26
Dry Inlet	39 20 31.28	74 27 57.42	55 10 59	New Inlet	235 09 22	4470.2	4888.5	2.78
			132 23 53	Risley's Landing	312 21 50	6288.7	6877.1	3.91
Leedsville	39 20 52.82	74 33 19.98	220 41 53	Risley's Landing	40 43 15	4715.9	5157.2	2.93
			30 49 53	Somers' Point	210 48 48	4812.8	5263.1	2.99
From Highlands of Navesink to Gt. Egg Harbor.								
Navesink	40 23 45.06	73 58 49.77	126 08 31	Mount Mitchell	306 07 41	2234.3	2443.4	1.39
			166 24 57	Sandy Hook	346 24 03	7524.5	8228.6	4.67
Navesink Light-house	40 23 42.43	73 58 48.62	183 16 14	Wyckoff	3 16 45	19941.7	21807.6	12.39
			221 17 29	Pavilion	41 26 30	29682.5	32459.8	18.44
Polhemus	40 19 00.00	74 08 36.62	133 02 12	Beacon Hill	312 59 07	9213.4	10075.5	5.72
			229 55 34	Mount Mitchel	30 01 05	15720.5	17191.5	9.77

United States Coast Survey.—Geographical Positions. Section II.—Coast of New Jersey. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Lippencott	40 15 17.63	74 07 18.27	83 32 44	Throckmorton	263 30 43	4528.6	4952.4	2.81
			164 54 23	Polhemus	344 53 33	7103.6	7768.3	4.41
Garriell	40 20 31.69	74 02 45.79	33 37 16	Lippencott	213 34 19	11628.5	12716.6	7.22
			71 10 41	Polhemus	251 06 54	8750.5	9569.3	5.44
Burdge	40 22 59.43	74 01 25.80	22 30 21	Garriell.	202 29 29	4931.9	5393.4	3.06
			54 02 45	Polhemus	233 58 06	12564.9	13740.6	7.81
Beach, (1)	40 20 39.12	73 58 01.68	88 04 04	Garriell	268 01 00	6708.6	7336.3	4.17
			131 57 44	Burdge	311 55 32	6474.0	7079.8	4.02
Beach, (2)	40 20 11.87	73 58 02.84	95 15 19	Garriell	275 12 16	6705.7	7333.2	4.17
			137 12 00	Burdge	317 09 49	7045.2	7704.4	4.38
Navesink, (2)	40 23 15.34	73 58 53.50	47 22 30	Garriell	227 19 58	7450.4	8147.5	4.63
			348 04 08	Beach, (2)	168 04 40	5783.5	6324.7	3.59
Ocean House, (flag-staff)	40 22 51.74	73 58 13.90	356 58 09	Beach, (2)	176 58 16	4937.7	5399.7	3.07
			93 00 53	Burdge	272 58 49	4532.2	4956.3	2.82
Shrewsbury Spire	40 19 22.20	74 03 21.63	51 25 57	Throckmorton	231 21 22	12908.2	14116.0	8.02
			84 45 44	Polhemus	264 42 20	7468.3	8167.0	4.64
Conover	40 20 38.28	74 01 07.42	263 37 42	Garriell	139 59 56	2330.3	2548.3	1.45
			174 18 54	Burdge	354 18 42	4374.7	4784.0	2.72
Liberty Pole	40 17 55.55	73 59 52.30	139 41 23	Garriell	319 39 30	6316.1	6907.1	3.92
			99 10 28	Polhemus	279 04 49	12530.3	13702.8	7.79
West	40 16 16.24	73 59 34.71	150 13 24	Garriell	330 11 20	9079.1	9928.6	5.64
			196 36 42	Beach, (2)	16 37 38	7584.5	8294.2	4.71

United States Coast Survey.—Geographical Positions. Section II.—Coast of New Jersey. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Red Bog	40 14 03.28	74 02 54.16	228 54 30	West	48 56 39	6238.2	6821.9	3.88
			180 53 52	Garriell	0 53 57	11979.2	13100.2	7.44
Christopher	40 04 10.42	74 11 36.75	184 35 01	Throckmorton	4 35 45	20130.9	22014.5	12.51
			135 10 47	Baird	315 02 28	25971.4	28401.5	16.14
Highland of Squam	40 06 07.68	74 04 17.70	151 57 13	Throckmorton	331 53 14	18644.8	20389.4	11.59
			70 52 01	Christopher	250 47 18	11011.0	12041.3	6.84
Fleming	40 00 12.97	74 03 11.79	171 52 49	Highland of Squam	351 52 07	11050.0	12083.9	6.86
			121 30 08	Christopher	301 24 43	14032.3	15345.3	8.72
Stout	39 57 34.71	74 04 15.43	139 25 33	Christopher	319 20 49	16076.0	17580.2	9.99
			197 11 02	Fleming	17 11 43	5108.9	5586.9	3.17
Green Island	40 00 32.22	74 06 06.49	334 17 26	Stout	154 18 37	6075.1	6643.5	3.77
			278 08 24	Fleming	98 10 16	4185.7	4577.4	2.60
Page	39 59 06.18	74 06 48.18	248 06 48	Fleming	68 09 07	5530.6	6048.1	3.44
			200 25 57	Green Island	20 26 24	2831.8	3096.7	1.76
Cranberry	39 56 37.21	74 03 58.55	189 27 40	Fleming	9 28 10	6745.6	7376.8	4.19
			138 47 21	Page	318 45 32	6108.0	6679.5	3.79
Goose Creek	39 57 04.97	74 06 20.38	252 48 13	Stout	72 49 33	3104.4	3394.4	1.93
			169 59 31	Page	349 59 13	3795.6	4150.8	2.36
Goodluck Point	39 55 18.58	74 06 47.10	190 56 34	Goose Creek	10 56 51	3341.8	3654.5	2.08
			238 46 13	Cranberry	58 48 01	4679.0	5116.8	2.91
Philipp	39 53 50.37	74 04 25.90	155 38 37	Goose Creek	335 37 24	6588.2	7204.7	4.09
			187 11 27	Cranberry	7 11 44	5186.1	5671.4	3.22

United States Coast Survey.—Geographical Positions. Section II.—Coast of New Jersey. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Cedar Creek	39 51 44.44	74 07 52.94	231 41 24	Philipp	51 43 37	6267.6	6854.0	3.89
			193 19 04	Goodluck Point	13 19 46	6786.8	7421.9	4.22
Island Beach	39 49 02.52	74 05 08.73	186 32 19	Philipp	6 32 46	8935.3	9771.4	5.55
			141 59 47	Cedar Creek	321 58 02	6338.2	6931.3	3.94
Forked River	39 49 19.83	74 09 08.41	201 54 35	Cedar Creek	21 55 23	4806.7	5256.5	2.99
			275 19 50	Island Beach	95 22 24	5724.6	6260.2	3.56
Barnegat Inlet	39 45 55.47	74 05 55.43	190 53 47	Island Beach	10 54 17	5874.2	6423.9	3.65
			143 56 41	Forked River	323 54 38	7797.1	8526.7	4.84
Double Creek	39 44 24.84	74 10 20.39	246 04 28	Barnegat Inlet	66 07 51	6898.6	7544.1	4.29
			190 39 17	Forked River	10 40 03	9257.1	10123.3	5.75
Barnegat Light-house	39 45 57.21	74 06 02.20	144 40 56	Forked River	324 38 57	7659.3	8376.0	4.76
			192 32 41	Island Beach	12 33 15	5854.4	6402.2	3.64
Great Swamp	39 40 39.53	74 08 39 32	160 53 50	Double Creek	340 52 45	7353.3	8041.4	4.57
			201 48 55	Barnegat Inlet	21 50 40	10495.9	11478.0	6.52
Hickory Island	39 41 11.94	74 12 43.12	209 44 04	Double Creek	29 45 35	6851.2	7492.3	4.26
			279 44 25	Great Swamp	99 47 00	5894.7	6446.3	3.66
Hickey	39 37 34.20	74 11 03.36	160 30 25	Hickory Island	340 29 21	7123.2	7789.7	4.42
			210 59 06	Great Swamp	31 00 38	6667.2	7291.0	4.14
Dinner Point	39 37 57.40	74 14 54.94	207 37 45	Hickory Island	27 39 09	6772.0	7405.7	4.21
			277 21 40	Hickey	97 24 08	5568.2	6089.2	3.46
Cramer	39 35 09.24	74 12 52.76	150 40 32	Dinner Point	330 39 14	5948.4	6505.0	3.70
			210 15 53	Hickey	30 16 03	5176.1	5660.4	3.22

United States Coast Survey.—Geographical Positions. Section II.—Coast of New Jersey. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Tuckerton	39 36 06.69	74 19 27.59	242 16 25	Dinner Point	62 19 13	7344.4	8031.6	4.56
			280 36 55	Cramer	100 41 07	9584.7	10481.5	5.96
Long Beach	39 33 15.89	74 14 21.23	211 07 42	Cramer	31 08 38	4083.7	4465.8	2.54
			125 47 52	Tuckerton	305 44 37	9010.1	9853.2	5.60
Cedar Hammock	39 34 07.05	74 20 19.06	198 24 29	Tuckerton	18 25 02	3888.5	4252.3	2.41
			280 25 56	Long Beach	100 29 44	8685.2	9497.9	5.40
Old Inlet	39 30 48.76	74 16 53.31	141 14 20	Cedar Hammock	321 12 09	7843.4	8577.3	4.87
			218 39 29	Long Beach	38 41 06	5811.2	6354.9	3.61
Leed's Point	39 28 58.63	74 25 39.63	218 48 12	Cedar Hammock	38 51 36	12209.0	13351.4	7.58
			254 50 19	Old Inlet	74 55 54	13024.6	14243.3	8.09
Little Egg Harbor Light	39 30 18.41	74 16 48.02	144 27 54	Cedar Hammock	324 25 40	8666.0	9476.9	5.38
			79 05 03	Leed's Point	258 59 25	12937.1	14147.6	8.04
Brigantine Beach	39 25 48.98	74 19 37.01	202 55 26	Old Inlet	22 57 10	10038.3	10977.6	6.23
			124 02 20	Leed's Point	303 58 29	10456.7	11435.2	6.50
Peter's Beach	39 23 16.50	74 24 01.60	167 28 56	Leed's Point	347 27 54	10807.4	11818.7	6.72
			233 22 09	Brigantine Beach	53 24 57	7882.1	8619.6	4.90
Absecum	39 25 08.55	74 29 06.57	214 52 10	Leed's Point	34 54 22	8649.4	9458.7	5.37
			295 18 58	Peter's Beach	115 22 12	8072.4	8827.7	5.02

United States Coast Survey.—Geographical Positions. Section III.—Primary Stations. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
FROM KENT ISLAND BASE NORTHWARD.								
KENT ISLAND BASE { S. End.	38 53 50.51	76 21 39.35						
KENT ISLAND BASE { N. End.	38 58 23.17	76 20 08.46	14 36 02.5	South Base	194 35 05.4	8687.6	9500.5	5.49
Marriott	38 52 24.15	76 36 16.41	262 44 36.9	South Base	82 53 47.5	21303.3	23296.6	13.24
			244 30 59.1	North Base	64 41 07.3	25808.8	28223.7	16.04
Taylor	38 59 45.01	76 27 37.08	321 43 49.2	South Base	141 47 34.1	13916.6	15218.8	8.65
			283 06 57.1	North Base	103 11 39.3	11087.1	12124.5	6.89
			42 39 41.6	Marriott	222 34 15.2	18471.5	20199.9	11.48
Linstid	39 05 18.39	76 28 49.96	315 32 38.5	North Base	135 33 06.9	17922.5	19599.5	11.13
			350 19 04.6	Taylor	170 19 50.6	10427.9	11403.6	6.48
			24 16 12.4	Marriott	204 11 31.5	26179.3	28628.9	16 27
Swan Point	39 08 27.07	76 16 29.54	15 48 06.3	North Base	195 45 48.4	19350.3	21160.9	12.02
			71 57 04.5	Linstid	251 49 17.4	18713.2	20464.2	11.63
Pool's Island	39 17 04.52	76 15 30.40	41 27 23.9	Linstid	221 18 58.7	29021.1	31746.6	18.03
			5 05 09.4	Swan Point	185 04 32.0	16018.6	17517.5	9.95
Finlay	39 24 24.76	76 31 09.65	354 34 31.6	Linstid	174 36 00.0	35507.5	38830.0	22.06
			301 02 09.0	Pool's Island	121 12 04.5	26267.9	28725.8	16.32
Osborne's Ruin	39 27 51.70	76 16 33.85	355 38 35.9	Pool's Island	175 39 16.2	20014.5	21887.3	12.44
			73 07 50·9	Finlay	252 58 34.6	21892.6	23941.1	13.60
Turkey Point	39 26 55.02	76 00 15.68	50 19 51.1	Pool's Island	230 10 10.9	28476.6	31141.2	17.70
			94 21 40.1	Osborne's Ruin	274 11 18.5	23447.9	25641.9	14.57

United States Coast Survey.—Geographical Positions. Section III.—Primary Stations. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Principio	39 35 33.47	75 59 57.25	59 11 41.5	Osborne's Ruin	239 01 07.2	27733.4	30328.4	17.23
			1 34 44.1	Turkey Point	181 34 32.3	15993.3	17489.8	9.94
From Chesapeake Bay to Washington.								
Webb	39 05 23.23	76 40 11.42	346 43 51.8	Marriott	166 46 19.7	24678.9	26988.1	15.33
			270 27 45.2	Linstid	90 34 54.9	16375.9	17908.2	10.18
Hill	38 53 51.54	76 52 31.15	276 27 30.5	Marriott	96 37 42.5	23644.0	25856.3	14.69
			219 46 58.6	Webb	39 54 43.9	27779.4	30378.7	17.26
Soper	39 05 08.55	76 56 42.11	268 49 25.7	Webb	88 59 50.3	23811.0	26039.0	14.79
			343 50 36.5	Hill	163 53 14.3	21730.9	23764.2	13.50
			308 31 02.5	Marriott	128 43 53.5	37758.5	41291.6	23.46
Causten	38 55 31.96	77 04 05.29	280 25 45.9	Hill	100 33 01.9	17006.0	18597.3	10.57
			210 54 44.4	Soper	30 59 23.4	20730.7	22670.5	12.88
Seminary	38 49 10.24	77 05 13.71	244 40 32.2	Hill	64 48 30.7	20327.2	22229.2	12.63
			187 58 15.8	Causten	7 58 58.7	11884.7	12996.8	7.38
National Observatory	38 53 38.96	77 02 47.29	248 26 57	Hill	88 33 24	14851.0	16240.6	9.23
			151 40 02	Causten	331 39 13	3958.6	4329.0	2.46
Capitol Dome	38 53 19.89	77 00 15.00	264 58 09	Hill	85 03 01	11219.5	12269.3	6.97
			126 17 53	Causten	306 15 28	6882.0	7526.0	4.28
Seaton	38 53 25.60	76 59 40.98	265 32 46	Hill	85 37 16	10388.0	11360.0	6.45
			121 29 01	Causten	301 26 15	7465.0	8163.5	4.64

United States Coast Survey.—Geographical Positions. Section III.—Primary Stations. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
FROM KENT ISLAND BASE SOUTHWARD.	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Poplar Island, (1)	38 45 25.65	76 22 53.29	186 31 46.6	South Base	6 32 33.7	15668.1	17114.2	9.74
			123 44 08.3	Marriott	303 35 44.8	23277.1	25455.1	14.46
Blake	38 39 41.88	76 31 55.79	165 02 16.3	Marriott	344 59 33.1	24330.5	26607.1	15.02
			230 59 16.9	Poplar Island, (1)	51 04 56.2	16855.6	18432.8	10.47
Hill's Point	38 34 04.14	76 18 37.26	163 36 35.7	Poplar Island	343 33 55.7	21905.4	23955.1	13.61
			118 23 51.6	Blake	298 15 33.3	21944.5	23997.8	13.64
Travers	38 28 06.84	76 19 30.85	139 59 04.9	Blake	319 51 20.5	28007.0	30627.6	17.40
			186 42 59.9	Hill's Point	6 43 33.3	11092.5	12130.4	6.89
Wilson	38 26 18.29	76 26 39.38	162 50 44.0	Blake	342 47 26.8	25933.6	28360.2	16.12
			219 04 39.4	Hill's Point	39 09 39.4	18512.9	20245.2	11.50
			252 06 29.6	Travers	72 10 56.1	10915.0	11936.3	6.78
Calvert	38 21 30.68	76 23 16.16	204 05 13.0	Travers	24 07 33.0	13381.0	14633.1	8.31
			150 56 27.7	Wilson	330 54 21.5	10146.1	11095.5	6.30
Meekin's Neck	38 23 10.66	76 16 42.09	155 52 16.6	Travers	335 50 31.7	10006.8	10943.1	6.22
			72 10 11.7	Calvert	252 06 07.1	10048.9	10989.2	6.24
Cedar Point	38 17 54.09	76 21 42.77	161 14 57.3	Calvert	341 13 59.4	7052.2	7712.1	4.38
			216 46 17.9	Meekin's Neck	36 49 24.4	12188.7	13369.2	7.57
Tom's Point	38 15 37.91	76 10 54.48	148 51 42.6	Meekin's Neck	328 48 07.1	16312.5	17838.9	10.14
			104 58 29.4	Cedar Point	284 51 47.8	16304.5	17830.1	10.13

United States Coast Survey.—Geographical Positions. Section III.—Primary Stations. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Point No Point	38 08 27.45	76 19 04.11	167 33 27.2	Cedar Point	347 31 49.0	17890.8	19564.9	11.12
			221 52 00.1	Tom's Point	41 57 02.9	17833.7	19502.4	11.08
Holland	38 06 36.29	76 05 14.88	153 42 03.4	Tom's Point	333 38 33.4	18631.8	20375.2	11.58
			99 42 08.5	Point No Point	279 33 36.6	20483.2	22399.8	12.73
Point Lookout	38 02 44.75	76 19 04.90	180 06 13.2	Point No Point	0 06 13.7	10565.4	11554.0	6.56
			250 29 24.1	Holland	70 37 56.0	21449.4	23456.4	13.33
Smith's Point Light-House	37 53 14.59	76 13 58.50	165 10 55.4	Point No Point	345 07 47.0	29114.3	31838.5	18.09
			207 16 40.0	Holland	27 22 02.2	27819.0	30422.0	17.28
			156 57 57.1	Point Lookout	336 54 48.4	19103.6	20891.1	11.87
Shank's Hammock	37 55 15.59	76 02 09.48	167 51 20.6	Holland	347 49 26.5	21467.4	23476.1	13.34
			119 17 13.0	Point Lookout	299 06 48.1	28383.7	31039.5	17.64
			77 54 10.0	Smith's Point Light House	257 46 54.5	17711.2	19368.4	11.00
Tangier Island	37 47 53.82	75 58 56.11	114 13 35.5	Smith's Point Light-House	294 04 22.0	24171.1	26432.8	15.02
			160 52 42.1	Shank's Hammock	340 50 43.5	14415.7	15764.6	8.96
Windmill Point	37 36 41.82	76 16 14.63	186 12 41.9	Smith's Point Light-House	6 14 05.4	30786.3	33667.0	19.13
			230 45 04.6	Tangier Island	50 55 39.8	32804.5	35874.0	20.37
Sandy Point	37 33 38.48	75 56 17.92	171 39 05.4	Tangier Island	351 37 28.7	26651.1	29144.8	16.56
			100 59 55.1	Windmill Point	280 47 45.2	29896.2	32693.5	18.58
Wolf Trap	37 24 00.73	76 14 24.32	173 25 21.8	Windmill Point	353 24 14.6	23617.6	25827.5	14.67
			236 11 32.0	Sandy Point	56 22 33.1	32085.4	35087.6	19.94
Rosemary	37 19 54.83	76 00 29.21	193 39 00.0	Sandy Point	13 41 32.7	26130.4	28575.3	16.24
			110 19 14.0	Wolf Trap	290 10 47.1	21900.4	23949.6	13.61

United States Coast Survey.—Geographical Positions. Section III.—Head of Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
HEAD OF CHESAPEAKE BAY.								
Maulden's Mountain........	39 29 11.98	75 59 07.84	174 16 38	Principio....................	354 16 06	11822.5	12928.9	7.35
			84 26 10	Osborne's Ruin..............	264 15 05	25120.0	27470.5	15.60
Prospect Hill..............	39 26 08.83	76 20 36.74	239 25 53	Principio....................	59 39 05	34346.3	37560.1	21.34
			259 29 58	Maulden's Mountain.........	79 43 35	31323.3	34254.2	19.46
Worton Point..............	39 19 03.32	76 10 51.86	133 11 54	Prospect Hill...............	313 05 45	19185.7	20980.9	11.92
			221 50 34	Maulden's Mountain.........	41 58 04	25217.7	27577.3	15.67
Miller's Island............	39 15 41.74	76 29 52.56	181 07 09	Prospect Hill...............	1 07 17	19340.2	21149.9	12.02
			246 35 29	Worton Point...............	63 41 49	15678.9	17146.0	9.74
Mitchell's Bluff...........	39 13 06.17	76 14 14.83	116 44 07	Miller's Island..............	296 39 55	10675.6	11674.5	6.63
			203 49 03	Worton Point...............	23 51 11	12039.7	13166.3	7.48
Swan Point................	39 08 27.07	76 16 29.54	154 48 33	Miller's Island..............	334 45 47	14814.0	16200.0	9.20
			200 31 49	Mitchell's Bluff.............	20 36 14	9192.9	10053.1	5.71
Black Marsh..............	39 12 25.25	76 25 06.51	225 07 36	Miller's Island..............	45 10 17	8590.2	9394.0	5.34
			300 34 30	Swan Point..................	120 39 57	14419.0	15768.2	8.96
Gibson's Island............	39 04 36.40	76 25 09.28	240 17 15	Swan Point..................	60 22 46	14370.1	15714.7	8.93
			180 15 46	Black Marsh.................	0 15 45	14456.9	15809.6	8.98
Northeast River.								
Locust Point..............	39 28 21.53	76 03 56.25	257 15 17	Maulden's Mountain.........	77 18 20	7065.0	7726.1	4.39
			203 19 29	Principio....................	23 12 52	14499.0	15845.8	9.00

United States Coast Survey.—Geographical Positions. Section III.—Head of Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Carpenter's Point	39 32 28.79	76 00 20.17	34 06 54	Locust Point	214 04 37	9206.7	10068.2	5.72
			344 06 10	Maulden's Mountain	164 06 56	6309.7	6900.1	3.92
Bull's Mountain	39 30 23.04	75 58 30.95	64 17 28	Locust Point	244 14 02	8627.8	9435.1	5.36
			146 04 57	Carpenter's Point	326 03 46	4673.1	5110.4	2.90
Hance's Point	39 33 20.63	75 57 50.43	13 33 42	Maulden's Mountain	193 32 55	7886.5	8624.5	4.90
			65 55 18	Carpenter's Point	245 53 42	3915.6	4282.0	2.43
Seneca Point	39 33 47.95	75 59 05.49	36 09 01	Carpenter's Point	216 08 13	3022.4	3305.2	1.88
			295 10 45	Hance's Point	115 11 33	1979.6	2164.8	6.82
Ford's Farm	39 34 27.81	75 56 50.04	34 50 41	Hance's Point	214 50 03	2524.2	2760.4	1.57
			53 49 42	Carpenter's Point	233 47 28	6215.7	6797.3	3.86
Red Bank	39 31 38.61	75 58 32.05	120 56 55	Carpenter's Point	300 55 48	3009.7	3291.3	1.87
			61 00 51	Highlands of Narrows	240 56 16	11777.6	12879.6	7.32
Sweet's Landing	39 35 28.10	75 57 15.32	12 02 33	Hance's Point	192 02 13	4018.8	4394.9	2.50
			342 00 43	Ford's Farm	162 00 58	1954.2	2137.1	1.21
Susquehanna River.								
Highlands of Narrows	39 28 33.30	76 05 43.15	262 46 06	Maulden's Mountain	82 50 17	9521.6	10412.5	5.92
			212 29 08	Principio	32 32 48	15365.3	16803.0	9.55
Furnace	39 35 24.37	75 59 51.98	348 14 01	Bull's Mountain	168 14 53	10867.1	11883.9	6.75
			7 05 08	Carpenter's Point	187 04 50	5456.1	5966.6	3.39
Davis' Point	39 30 39.45	76 06 16.07	248 19 47	Carpenter's Point	68 23 33	9144.0	9999.6	5.68
			272 34 01	Bull's Mountain	92 38 57	11121.9	12162.6	6.91

United States Coast Survey.—Geographical Positions. Section III.—Head of Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Shad Battery	39 29 36.53	76 04 41.34	260 45 49	Bull's Mountain	80 49 45	8963.6	9802.3	5.57
			130 37 39	Davis' Point	310 36 39	2931.5	3260.5	1.85
Susquehanna Light	39 32 23.28	76 04 47.12	306 01 21	Maulden's Mountain	126 04 57	10023.6	10961.6	6.23
			231 34 32	Furnace	51 37 40	8988.2	9829.2	5.59
Lower Stump Point	39 32 44.56	76 02 30.44	307 19 32	Bull's Mountain	127 22 01	7194.3	7867.5	4.47
			323 32 45	Maulden's Mountain	143 34 59	8147.8	8910.2	5.06
Stump Point	39 32 58.54	76 03 49.94	302 09 42	Bull's Mountain	122 13 09	9001.2	9843.4	5.59
			18 18 25	Highlands of Narrows	198 17 17	8614.9	9421.0	5.35
Havre-de-Grace	39 32 15.63	76 04 57.57	9 01 41	Highlands of Narrows	189 01 12	6942.2	7591.8	4.31
			266 28 09	Carpenter's Point	86 31 06	6636.0	7256.9	4.12
Havre-de-Grace Spire	39 32 49.23	76 05 13.63	307 27 00	Maulden's Mountain	127 30 53	11009.5	12039.7	6.84
			238 02 52	Furnace	58 06 17	9044.3	9890.6	5.62
Mount Zion	39 33 39.57	76 07 21.80	304 55 46	Maulden's Mountain	125 01 00	14396.6	15743.7	8.94
			251 38 37	Principio	71 43 20	11175.0	12220.7	6.94
Ryan's Hill	39 35 19.40	76 04 20.80	8 55 53	Highlands of Narrows	188 55 01	12676.2	13862.3	7.88
			317 32 43	Bull's Mountain	137 36 26	12381.2	13539.7	7.69
Grover's Hill	39 33 44.46	76 05 54.54	217 22 15	Ryan's Hill	37 23 09	3685.1	4029.9	2.29
			300 20 53	Bull's Mountain	120 25 41	12536.4	13709.4	7.79
Watson's Island	39 33 33.30	76 04 52.48	193 00 32	Ryan's Hill	13 00 50	3358.6	3672.9	2.09
			302 44 45	Bull's Mountain	122 48 51	10861.2	11877.5	6.74
Boyce's Hill	39 35 37.61	76 04 50.43	308 27 02	Ryan's Hill	128 27 21	902.8	987.3	0.56
			0 43 52	Watson's Island	180 43 51	3834.0	4192.8	2.38

United States Coast Survey.—Geographical Positions. Section III.—Head of Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Boyd	39 35 29.87	76 07 22.92	315 01 32	Watson's Island	135 03 08	5080.8	5556.2	3.16
			266 14 04	Boyce's Hill	86 15 41	3646.1	3987.3	2.27
Wells' Hill	39 36 40 60	76 06 57.18	302 42 26	Boyce's Hill	122 43 47	3593.8	3930.1	2.23
			15 43 27	Boyd	195 43 11	2265.8	2477.8	1.41
Lower Island	39 36 17.71	76 07 27.77	225 57 02	Wells' Hill	45 57 21	1015.1	1110.1	0.63
			355 30 52	Boyd	175 30 56	1479.9	1618.4	0.92
Paradise	39 39 50.01	76 08 07.66	283 08 40	Maulden's Mountain	103 14 23	13245.7	14485.1	8.23
			234 23 44	Furnace	54 29 00	14545.4	15906.5	9.04
Paca's House, (south chimney.)	39 32 56.94	76 07 25.58	343 14 32	Highlands of Narrows	163 15 37	8490.1	9284.5	5.28
			290 20 37	Bull's Mountain	110 26 17	13621.1	14895.6	8.46
Mulberry Point	39 26 39.48	76 05 51.45	266 32 08	Turkey Point, (2)	86 35 46	8025.2	8776.1	4.99
			170 33 30	Mount Zion	350 32 28	13133.1	14362.1	8.16
Turkey Point, (2)	39 26 55.06	76 00 16.49	140 52 33	Mount Zion	320 48 03	16088.1	17593.5	10.00
			181 38 41	Principio	1 38 51	15992.6	17489.0	9.94
Turkey Point Light	39 26 56.27	76 00 12.26	116 10 52	Locust Point	296 08 30	5964.4	6522.5	3.71
			214 02 32	Collar Neck	34 03 09	2468.2	2699.2	1.53
Collar Neck	39 28 02.57	75 59 14.47	94 59 17	Locust Point	274 56 18	6759.4	7391.9	4.22
			35 27 23	Turkey Point, (2)	215 26 44	2555.8	2795.0	1.59
Wroth's Point	39 25 47.62	75 59 29.99	126 44 29	Locust Point	306 41 31	7940.0	8682.9	4.93
			185 05 42	Collar Neck	5 05 52	4178.6	4569.6	2.60
Pearce	39 26 24.03	75 57 51.79	64 27 28	Wroth's Point	244 26 26	2603.4	2847.0	1.62
			146 57 52	Collar Neck	326 56 59	3625.5	3964.7	2.25

United States Coast Survey.—Geographical Positions. Section III.—Head of Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Arnold's Bar	39 27 42.67	75 57 40.32	36 28 22	Wroth's Point	216 27 12	4411.9	4824.7	2.74
			105 15 46	Collar Neck	285 14 46	2332.3	2550.5	1.45
Elk River.								
Martin's High Bank	39 29 57.79	75 55 49.52	73 24 55	Maulden's Mountain	253 22 51	4944.6	5407.3	3.07
			34 21 19	Wroth's Point	214 18 57	9343.0	10217.2	5.81
Ford's Landing	39 28 16.06	75 56 28.64	114 23 43	Maulden's Mountain	294 22 02	4176.9	4567.7	2.69
			196 35 33	Martin's High Bank	16 35 58	3273.3	3579.6	2.03
Stony Battery	39 28 03.21	75 54 06.46	106 25 54	Maulden's Mountain	286 22 47	7508.2	8211.1	4.67
			145 07 53	Martin's High Bank	325 06 41	4306.5	4709.9	2.68
Town Point	39 29 42.12	75 54 32.71	104 45 36	Martin's High Bank	284 44 52	1897.6	2075.2	1.18
			81 58 41	Maulden's Mountain	261 55 41	6638.6	7259.8	4.13
Hart's Hill	39 30 42.01	75 56 52.89	298 52 10	Town Point	118 53 49	3823.8	4181.9	2.38
			11 34 38	Arnold's Bar	191 34 16	5644.0	6172.3	3.51
Fairview	39 31 11.98	72 51 50.37	54 27 55	Town Point	234 26 15	4766.3	5212.3	2.96
			70 32 23	Maulden's Mountain	250 27 42	11086.6	12124.2	6.89
Pearce	39 30 56.99	75 53 47.23	25 13 11	Town Point	205 12 42	2551.6	2790.5	1.59
			84 04 34	Hart's Hill	264 02 36	4458.5	4875.7	2.77
Ford	39 28 24.83	75 56 01.98	221 49 36	Town Point	41 50 33	3198.5	3497.8	1.99
			163 58 22	Hart's Hill	343 57 50	4401.4	4813.2	2.74
Bohemia River.								
Folk	39 29 07.03	75 54 52.95	135 38 40	Hart's Hill	315 37 24	4097.2	4480.6	2.55
			51 44 49	Ford	231 44 05	2101.3	2297.9	1.31

United States Coast Survey.—Geographical Positions. Section III.—Head of Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Stony Point	39 28 42.03	75 52 49.98	83 25 54	Ford	263 23 52	4619.1	5051.3	2.87
			284 41 59	Folk	104 43 17	3038.0	3322.3	1.89
Pennington	39 28 02.29	75 52 53.93	184 24 30	Stony Point	4 24 32	1228.9	1344.0	0.76
			125 04 57	Folk	305 03 41	3475.0	3800.2	2.16
Bayard	39 27 56.13	75 51 40.99	130 39 28	Stony Point	310 38 44	2173.0	2376.3	1.35
			96 14 08	Pennington	276 13 22	1753.6	1917.7	1.09
McLane	39 27 14.53	75 51 39.96	148 12 11	Stony Point	328 11 26	3175.0	3472.2	1.97
			178 54 22	Bayard	358 54 21	1282.9	1403.1	0.80
Chesapeake Bay.								
Bear Point	39 26 50.62	76 03 24.51	234 34 53	Maulden's Mountain	54 37 36	7525.6	8229.9	4.68
			197 44 52	Furnace	17 47 07	16634.4	18190.4	10.34
Carroll's Island	39 18 44.07	76 18 56.02	26 25 27	Miller's Island	206 24 15	6277.4	6864.8	3.90
			170 02 24	Prospect Hill	350 01 20	13924.6	15227.4	8.65
Cool Spring	39 23 52.04	76 02 00.76	133 07 03	Mulberry Point	313 04 34	7557.9	8265.1	4.70
			203 50 09	Turkey Point, (2)	23 51 18	6171.3	6748.8	3.84
Bare Point	39 26 06.25	76 04 31.75	256 07 31	Turkey Point, (2)	76 10 14	6288.0	6876.4	3.91
			318 52 30	Cool Spring	138 54 04	5493.6	6007.7	3.42
Stephenson	39 24 30.73	76 07 58.15	239 09 33	Bare Point	59 11 44	5749.5	6287.5	3.57
			277 54 42	Cool Spring	97 58 29	8634.4	9442.3	5.36
Howell's Point	39 22 15 52	76 06 20.95	200 09 20	Bare Point	20 10 29	7580.1	8289.4	4.71
			150 51 05	Stephenson	330 50 03	4774.5	5221.3	2.97

United States Coast Survey.—Geographical Positions. Section III.—Head of Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Taylor's Island	39 22 44.03	76 10 15.97	225 03 22	Stephenson	45 04 49	4658.9	5094.8	2.90
			278 51 37	Howell's Point	98 54 06	5694.1	6226.9	3.54
Abbey Island	39 20 51.21	76 13 17.41	231 17 35	Taylor's Island	51 19 30	5565.5	6086.3	3.46
			283 43 31	Plum Point	103 46 10	6180.6	6758.3	3.84
Plum Point	39 20 03.59	76 09 06.74	224 16 47	Howell's Point	44 18 32	5684.6	6216.5	3.53
			191 15 56	Stephenson	11 16 40	8400.3	9186.3	4.60
Lego's Point	39 20 06.62	76 14 55.92	288 26 33	Worton Point	108 29 08	6163.6	6740.3	3.82
			239 45 05	Abbey Island	59 46 07	2730.7	2986.2	1.70
Sassafras River.								
Canby	39 22 04.75	76 03 22.23	167 25 05	Bare Point	347 24 21	7631.3	8345.4	4.74
			124 18 36	Stephenson	304 15 41	7991.8	8739.6	4.97
Grove Point	39 23 28.65	76 02 06.64	144 28 31	Bare Point	324 26 59	5972.9	6531.8	3.71
			102 51 12	Stephenson	282 47 29	8626.2	9433.5	4.74
Goldsborough	39 22 01.04	75 59 45.41	91 16 48	Canby	271 14 31	5190.7	5676.4	3.23
			128 39 33	Grove Point	308 38 04	4326.4	4731.2	2.69
Old Orchard Point	39 23 03.82	75 59 51.71	355 33 22	Goldsborough	175 33 26	1941.7	2123.4	1.21
			70 08 26	Canby	250 06 13	5357.5	5858.9	3.32
Clarke	39 21 49.85	75 57 31.14	96 08 38	Goldsborough	276 07 13	3232.5	3535.0	2.01
			124 09 15	Old Orchard Point	304 07 46	4064.5	4444.8	2.53
Cassidy	39 22 51.39	75 57 43.06	62 04 55	Goldsborough	242 03 38	3314.4	3624.5	2.06
			351 37 10	Clarke	171 27 18	1919.0	2093.6	1.23

United States Coast Survey.—Geographical Positions. Section III.—Head of Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Knight's Island	39 22 18.97	75 56 04.28	66 39 18	Clarke	246 38 23	2264.7	2476.6	1.41
			112 56 12	Cassidy	292 55 09	2566.8	2807.0	1.60
Ferguson	39 21 22.48	75 55 50.80	135 35 34	Cassidy	315 34 23	3838.7	4198.0	2.39
			169 31 02	Knight's Island	349 30 54	1771.4	1937.2	1.11
Reasin	39 21 33.54	75 54 26.98	121 02 27	Knight's Island	301 01 25	2717.8	2972.1	1.69
			80 22 08	Ferguson	260 21 14	2035.5	2226.0	1.27
Wicker	39 22 10.46	75 54 26.71	53 41 53	Ferguson	233 40 59	2498.2	2732.0	1.55
			0 19 45	Reasin	180 19 45	1138.5	1845.0	0.71
Hall	39 22 06.32	75 53 32.82	52 04 07	Reasin	232 03 33	1643.7	1797.5	1.02
			95 40 17	Wicker	275 39 43	1296.1	1417.4	0.81
Hurtz	39 21 32.05	75 53 33.64	133 00 34	Wicker	313 00 01	1736.8	1899.3	1.08
			181 04 12	Hall	1 04 13	1056.8	1155.7	0.66
Maldenburg	39 21 22.67	75 52 54.42	145 40 43	Hall	325 40 19	1629.7	1782.2	1.01
			107 07 55	Hurtz	287 07 30	982.3	1074.2	0.61
Ford	39 22 04.68	75 52 42.15	50 47 03	Hurtz	230 46 30	1591.0	1739.9	0.99
			12 47 03	Maldenburg	192 46 55	1328.2	1452.5	0.82
Eldredge	39 22 04.14	75 52 03.48	43 38 57	Maldenburg	223 38 25	1767.2	1932.6	1.10
			91 01 37	Ford	271 01 13	925.8	1012.4	0.58
Gregg	39 21 44.03	75 51 43.49	114 24 25	Ford	294 23 48	1541.8	1686.1	0.96
			142 22 14	Eldredge	322 22 01	783.4	856.7	0.49
Briscoe	39 21 50.97	75 50 42.34	101 49 39	Eldredge	281 48 47	1984.0	2169.6	1.23
			81 41 12	Gregg	261 40 33	1479.2	1617.6	0.92

United States Coast Survey.—Geographical Positions. Section III.—Head of Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Bush River.								
Battery	39 21 47.78	76 10 25.31	329 38 19	Plum Point	149 39 09	3723.8	4072.2	2.31
			7 09 06	Worton Point	187 08 49	5112.2	5590.6	3.18
Wilson	39 22 35.39	76 16 00.88	309 22 16	Abbey Island	129 23 59	5063.8	5537.6	3.15
			341 16 24	Lego's Point	161 17 05	4844.9	5298.2	3.01
Elliott	39 22 34.26	76 14 44.01	91 05 47	Wilson	271 04 58	1840.4	2017.6	1.14
			3 35 21	Lego's Point	183 35 13	4562.6	4989.5	2.84
Dorney	39 23 31.88	76 15 38.51	323 43 03	Elliott	143 43 37	2204.5	2410.8	1.37
			17 05 11	Wilson	197 04 57	1822.6	1993.2	1.32
Fair Point	39 24 37.99	76 15 02.15	353 30 34	Elliott	173 30 45	3840.7	4200.1	2.39
			23 06 45	Dorney	203 06 22	2216.8	2434.2	1.38
Chelsea	39 24 43.37	76 13 52.47	49 01 16	Dorney	229 00 09	3361.4	3675.9	2.09
			84 19 30	Fair Point	264 18 46	1675.3	1832.1	1.04
Chilby Point	39 26 16.25	76 14 00.49	25 57 33	Fair Point	205 56 54	3370.4	3685.8	2.09
			356 10 14	Chelsea	176 10 19	2871.1	3139.8	1.79
Kennard	39 26 04.05	76 14 47.44	332 08 52	Chelsea	152 09 26	2814.5	3077.9	1.75
			251 28 27	Chilby Point	71 28 56	1184.1	1294.9	0.74
Hollis	39 27 13.45	76 14 31.18	337 24 50	Chilby Point	157 25 10	1910.7	2089.5	1.19
			10 17 53	Kennard	190 17 43	2175.4	2379.0	1.35
Abingdon Cupola	39 27 38.22	76 16 23.32	263 12 21	Maulden's Mountain	83 25 40	24912.5	27243.8	15.48
			237 58 40	Principio	58 11 21	27733.6	30328.5	17.23

United States Coast Survey.—Geographical Positions. Section III.—Head of Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Birch Head	39 25 10.68	76 18 00.05	317 49 31	Worton Point	137 54 03	15276.2	16705.6	9.49
			6 25 04	Carroll's Island	186 24 28	11996.7	13119.2	7.45
Gunpowder River.								
Pool's Island Light	39 17 22.50	76 15 41.20	176 17 23	Osborne's Ruin	356 16 50	19442.7	21262.0	12.08
			345 18 47	Mitchell's Bluff	165 19 42	8170.5	8935.1	5.08
Pool's Island Signal	39 16 23.76	76 16 01.39	337 14 26	Mitchell's Bluff	157 15 34	6606.4	7224.6	4.10
			60 41 06	Black Marsh	240 35 22	14998.4	16401.8	9.32
Rickett's Point	39 18 11.58	76 17 26.18	114 58 06	Carroll's Island	294 57 09	2374.0	2596.1	1.48
			46 58 03	Miller's Island	226 55 52	6768.0	7401.3	4.21
Spry's Island	39 17 39.58	76 19 16.85	319 19 00	Mitchell's Bluff	139 22 11	11112.6	12152.9	6.90
			32 16 16	Miller's Island	212 15 15	4297.1	4699.4	2.67
Grace's Quarter	39 20 45.98	76 19 58.95	338 09 13	Carroll's Island	158 09 53	4050.3	2429.3	2.52
			322 26 51	Rickett's Point	142 28 28	6004.7	6566.6	3.73
Maxwell's Point	39 21 20.64	76 18 31.26	7 00 27	Carroll's Island	187 00 12	4864.3	5319.5	3.02
			63 02 10	Grace's Quarter	243 01 15	2355.7	2576.1	1.46
Harewood	39 22 17.78	76 20 01.37	358 49 52	Grace's Quarter	178 49 53	2831.1	3096.0	1.76
			309 14 23	Maxwell's Point	129 15 20	2785.1	3045.7	1.73
Piny Point	39 23 16.13	76 19 41.93	334 35 35	Maxwell's Point	154 36 19	2942.5	4311.4	2.45
			14 30 13	Harewood	194 30 00	1858.5	2032.4	1.16
Taylor's Mount	39 23 38.78	76 22 07.69	309 33 36	Harewood	129 34 56	3921.1	4288.0	2.43
			281 18 50	Piny Point	101 20 23	3556.8	3889.6	2.21

United States Coast Survey.—Geographical Positions. Section III.—Head of Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
Middle River.	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Carroll's Lower Island......	39 17 51.83	76 20 28.97	8 01 24	Miller's Island..............	188 01 09	4050.9	4430.2	2.52
			262 04 07	Rickett's Point.............	82 06 03	4421.5	4835.2	2.75
Holly Point North..........	39 17 08.18	76 22 43.85	247 22 59	Carroll's Lower Island.......	67 24 25	3500.8	3828.5	2.18
			179 18 08	Thick Neck Point...........	359 18 08	1250.0	1367.0	0.78
Thick Neck Point..........	39 17 48.72	76 22 44.49	325 34 36	Miller's Island..............	145 35 46	4746.2	5190.3	2.95
			268 17 57	Carroll's Lower Island.......	88 19 23	3248.2	3550.2	2.02
Piney Point...............	39 18 34.51	76 24 51.54	294 52 48	Thick Neck Point...........	114 54 09	3355.4	3669.4	2.08
			311 01 10	Holly Point North...........	132 02 31	4055.3	4434.9	2.52
Back River.								
Holly Point South..........	39 16 33.18	76 22 40.86	232 29 21	Carroll's Lower Island.......	52 30 44	3983.6	4356.5	2.48
			301 25 03	Miller's Island..............	121 26 11	3042.2	3326.9	1.90
Hart's Island..............	39 14 38.53	76 22 34.10	231 18 47	Miller's Island..............	51 19 51	3118.6	3410.4	1.93
			177 22 43	Holly Point South...........	357 22 39	3538.9	3870.0	2.20
Rocky Point...............	39 14 53.05	76 23 44.78	206 23 32	Holly Point South...........	26 24 13	3446.7	3769.3	2.14
			284 47 48	Hart's Island...............	104 48 33	1752.8	1916.9	1.09
Townsend.................	39 13 52.64	76 24 35.72	244 06 26	Hart's Island...............	64 07 43	3241.6	3544.9	2.01
			213 14 56	Rocky Point.................	33 15 28	2227.6	2436.1	1.39
Provin....................	39 14 47.86	76 24 38.50	275 29 55	Hart's Island...............	95 31 14	2996.6	3277.1	1.86
			357 45 25	Townsend...................	177 45 27	1704.0	1863.6	1.06

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Lynch	39 15 06.00	76 26 33.39	308 42 51	Townsend	128 44 06	3616.5	3954.9	2.25
			281 28 30	Provin	101 29 43	2810.7	3073.6	1.75
Porter	39 15 15.96	76 25 51.09	324 52 16	Townsend	144 53 04	3141.1	3435.2	1.95
			296 27 36	Provin	116 28 22	1944.2	2126.1	1.21
Stansbury's Point	39 16 13.92	76 26 42.96	353 45 05	Lynch	173 45 11	2106.6	2303.7	1.31
			325 10 32	Porter	145 11 05	2177.1	2380.8	1.25
Johnson	39 16 27.02	76 26 00.19	17 40 34	Lynch	197 40 13	2621.9	2867.2	1.63
			68 29 29	Stansbury's Point	248 29 02	1101.8	1205.0	0.68
Woodyard	39 17 28.44	76 27 38.86	329 45 26	Stansbury's Point	149 46 01	2659.8	2908.7	1.65
			308 41 11	Johnson	128 42 13	3029.3	3312.9	1.88
Patapsco River.								
Bodkin, (signal)	39 08 01.92	76 25 09.28	266 24 01	Swan Point	86 29 29	12505.4	13675.5	7.77
			0 00 04	Gibson's Island	180 00 02	6337.2	6930.2	3.94
North Point	39 11 40.81	76 26 29.70	292 46 43	Swan Point	112 52 56	15396.5	16837.2	9.57
			345 44 25	Bodkin	165 45 10	6963.5	7615.1	4.33
North Point *Lower* Light	39 11 35.93	76 26 12.48	292 32 45	Swan Point	112 38 53	15155.4	16573.5	10.42
			226 08 11	Black Marsh	46 08 53	2194.5	2399.8	1.37
North Point *Upper* Light	39 11 46.08	76 26 35.86	292 48 37	Swan Point	112 55 00	15794.6	17272.5	9.81
			343 15 33	Bodkin	163 16 28	7217.6	7893.0	4.48
Bodkin Light	39 08 01.89	76 25 09.58	239 06 02	Mitchell's Bluff	59 12 56	18302.6	20015.3	11.37
			266 24 04	Swan Point	86 29 32	12512.0	13682.8	7.77

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Rock Point Bank	39 08 39.13	76 26 59.05	201 09 55	Black Marsh..................	21 11 06	7477.2	8176.8	4.65
			293 30 30	Bodkin	113 31 39	2874.8	3143.6	1.79
22 Rock Point................	39 09 59.51	76 28 19.07	308 29 30	Bodkin	128 31 30	5823.2	6368.2	3.62
			222 16 31	North Point..................	42 17 46	4222.0	4617.1	2.62
Ridgely's Steeple House.....	39 12 27.33	76 25 22.37	357 48 08	Bodkin	177 48 16	8190.0	8956.3	5.09
			300 02 15	Swan Point...................	120 07 52	14779.6	16162.5	9.18
Sparrow Point	39 12 35.73	76 29 06.86	293 00 07	North Point..................	113 01 52	4331.3	4736.6	2.69
			346 36 12	Rock Point...................	166 36 42	4951.7	5415.0	3.08
Hawkins' Point..............	39 12 32.13	76 31 39.30	314 23 13	Rock Point...................	134 25 20	6725.8	7355.1	4.18
			268 15 04	Sparrow Point	88 16 40	3658.6	4000.9	2.27
Sollers' Point..............	39 13 36.71	76 30 30.42	313 10 11	Sparrow Point	133 11 04	2748.3	3005.5	1.71
			39 41 24	Hawkins' Point	219 40 40	2587.6	2829.7	1.61
Lazaretto...................	39 15 40.63	76 33 55.83	330 35 48	Hawkins' Point	150 37 14	6671.3	7295.5	4.15
			307 47 15	Sollers' Point...............	127 49 25	6233.9	6817.2	3.87
Fort McHenry, (flag-staff) ..	39 15 44.34	76 34 28.05	304 36 42	Sollers' Point...............	124 39 12	6924.7	7572.7	4.30
			325 39 40	Hawkins' Point	145 41 27	7176.4	7848.0	4.46
Snow Hill	39 12 20.86	76 35 08.31	250 38 19	Sollers' Point...............	70 41 15	7064.1	7725.1	4.39
			195 44 53	Lazaretto	15 45 39	6400.8	6999.7	3.98
Rosanne	39 17 27.49	76 42 45.82	232 16 16	Finlay	52 23 37	21056.1	23026.3	13.08
			318 11 22	Linstid	138 20 10	30128.6	32947.7	18.72
Washington Monument, Baltimore.	39 17 47.80	76 36 38.58	334 00 43	Linstid	154 05 39	25699.1	28103.8	15.96
			85 57 41	Rosanne......................	265 53 48	8821.7	9647.2	5.48

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
CHESTER RIVER.	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Carville	38 59 44.07	76 16 57.56	127 21 32	Gibson's Island	307 16 22	14868.8	16260.1	9.24
			182 23 23	Swan Point	2 23 41	16140.0	17650.2	10.03
Wright's Mill	38 58 09.21	76 14 18.35	127 22 08	Gibson's Island	307 16 05	19689.1	21531.4	12.23
			170 36 40	Swan Point	350 35 17	19310.0	21116.9	12.00
Wickes	39 01 47.46	76 14 17.47	45 21 55	Carville	225 20 14	5413.9	5920.5	3.37
			0 11 00	Wright's Mill	180 11 00	6729.5	7359.2	4.18
Wilson	39 05 35.00	76 13 49.27	5 31 33	Wickes	185 31 15	7048.7	7708.3	4.38
			22 43 34	Carville	202 41 35	11730.0	12827.6	7.29
Cedar Point	39 00 46.42	76 12 42.96	25 21 03	Wright's Mill	205 20 03	5363.2	5865.0	3.33
			72 36 01	Carville	252 33 20	6420.3	7021.1	3.99
Hail Point	39 00 43.91	76 11 36.45	39 15 31	Wright's Mill	219 13 49	6158.6	6734.9	3.83
			76 35 55	Carville	256 32 32	7943.2	8686.4	4.94
Lord's Gift	38 59 38.49	76 10 03.64	91 01 48	Carville	270 57 28	9961.5	10893.6	6.19
			132 06 32	Hail Point	312 05 34	3009.1	3290.7	1.87
Piny Point	39 02 41.87	76 10 46.65	349 37 59	Lord's Gift	169 38 26	5748.3	6286.2	3.57
			18 14 03	Hail Point	198 13 32	3829.4	4187.8	2.38
Eastern Neck Inlet	39 03 24.88	76 12 14.41	349 34 40	Hail Point	169 35 04	5046.8	5519.0	3.14
			302 08 49	Piny Point	122 09 45	2492.3	2725.5	1.51
Harris	39 05 38.14	76 10 55.61	357 44 04	Piny Point	177 44 09	5439.6	5948.6	3.38
			24 45 30	Eastern Neck Inlet	204 44 40	4524.5	4947.9	2.81

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles*
Lower Spaniard's Point	39 05 30.41	76 08 25.77	54 52 03	Eastern Neck Inlet	234 49 38	6721.6	7350.5	4.18
			93 48 31	Harris	273 46 57	3608.3	3945.9	2.24
Nichols	39 06 16.69	76 09 29.75	60 03 36	Harris	240 02 42	2380.7	2603.5	1.48
			312 52 10	Lower Spaniard's Point	132 52 50	2097.7	2294.0	1.30
Upper Spaniard's Point	39 05 49.23	76 07 58.39	48 34 17	Lower Spaniard's Point	228 34 00	877.3	959.4	0.55
			111 06 14	Nichols	291 05 16	2352.6	2572.7	1.46
Emory	39 06 12.99	76 06 29.66	91 31 53	Nichols	271 29 59	4328.4	4733.5	2.69
			71 03 06	Upper Spaniard's Point	251 02 11	2254.3	2465.2	1.40
Deep Point	39 06 28.35	76 06 50.03	52 43 05	Upper Spaniard's Point	233 42 23	2037.7	2228.4	1.27
			314 03 43	Emory	134 03 56	681.1	744.8	0.42
Commegys	39 06 58.43	76 06 18.20	39 30 53	Deep Point	219 30 33	1202.0	1314.5	0.75
			11 07 15	Emory	191 07 08	1427.9	1561.6	0.89
Mummey	39 06 47.62	76 05 59.28	34 21 08	Emory	214 20 49	1293.3	1414.2	0.80
			126 16 02	Commegys	306 15 50	563.4	616.1	0.35
Smith	39 07 21.76	76 05 17.25	43 48 27	Mummey	223 48 01	1458.7	1595.2	0.91
			63 50 02	Commegys	243 49 24	1631.2	1783.8	1.01
Shell Point	39 08 01.21	76 04 53.79	46 20 06	Commegys	226 19 13	2803.1	3065.4	1.74
			24 52 01	Smith	204 51 46	1340.5	1468.0	0.83
Holliday	39 07 40.26	76 04 27.16	64 38 55	Smith	244 38 23	1331.4	1456.0	0.83
			135 17 50	Shell Point	315 17 33	908.9	993.9	0.57
Gauld	39 08 37.38	76 03 31.38	60 35 57	Shell Point	240 35 05	2271.5	2484.0	1.41
			37 15 27	Holliday	217 14 52	2212.9	2420.0	1.37

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Vickers	39 09 16.73	76 04 14.76	5 43 20	Holliday	185 43 12	2989.6	3269.3	1.86
			319 21 26	Gauld	139 21 53	1598.9	1748.5	0.99
S. Merritt	39 09 44.51	76 03 04.90	17 04 59	Gauld	197 04 43	2165.3	2367.9	1.35
			62 57 09	Vickers	242 56 25	1883.2	2059.4	1.17
Wilmer	39 09 23.40	76 02 36.23	85 02 31	Vickers	265 01 29	2374.3	2596.5	1.48
			133 24 40	S. Merritt	313 24 22	947.3	1035.9	0.59
Harrison	39 10 08.61	76 01 36.07	70 47 38	S. Merritt	250 46 42	2258.0	2469.3	1.40
			46 00 59	Wilmer	226 00 21	2007.2	2195.0	1.25
Clements	39 10 54.92	76 02 00.57	16 52 54	Harrison	196 52 32	1544.1	1688.6	0.96
			337 37 30	Wilmer	157 37 46	2949.0	3224.9	1.83
J. W. Merritt	39 10 42.46	76 03 25.43	334 09 09	Wilmer	154 09 40	2708.8	2962.3	1.68
			259 18 53	Clements	79 19 46	2072.6	2266.5	1.29
Clarke	39 11 19.45	76 04 02.62	284 28 31	Clements	104 29 48	3025.1	3308.2	1.88
			321 57 36	J. W. Merritt	141 58 00	1448.3	1583.8	0.90
Primrose, (1)	39 11 35.78	76 03 34.35	352 35 11	J. W. Merritt	172 35 17	1658.0	1813.1	1.03
			53 25 37	Clarke	233 25 19	844.8	923.9	0.53
Chestertown, (1)	39 12 06.67	76 03 43.47	17 31 32	Clarke	197 31 20	1526.8	1669.8	0.96
			347 04 14	Primrose, (1)	167 04 20	977.3	1068.8	0.61
Chestertown, (2)	39 12 39.99	76 03 11.25	15 38 46	Primrose, (1)	195 38 31	2056.0	2248.4	1.28
			36 57 51	Chestertown, (1)	216 57 30	1285.6	1405.9	0.80
Wiley's Point	39 12 46.70	76 02 25.30	56 39 28	Chestertown, (1)	236 38 38	2244.9	2455.0	1.40
			79 22 28	Chestertown, (2)	259 21 59	1121.4	1226.3	0.70

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Hopewell	39 13 15.34	76 02 10.46	53 13 48	Chestertown, (2)	233 13 09	1820.6	1991.0	1.13
			21 57 55	Wiley's Point	201 57 46	952.2	1041.3	0.59
Primrose, (2)	39 13 25.14	76 01 15.48	54 43 01	Wiley's Point	234 42 17	2051.9	2243.6	1.28
			77 05 33	Hopewell	257 04 58	1352.9	1479.5	0.84
Wallis	39 14 03.54	76 00 51.79	51 46 54	Hopewell	231 46 04	2401.8	2626.5	1.49
			25 38 36	Primrose, (2)	205 38 21	1313.1	1436.0	0.82
Opossum Point	39 14 09.35	76 00 09.97	49 03 47	Primrose, (2)	229 03 06	2080.0	2274.6	1.29
			79 52 18	Wallis	259 51 52	1018.6	1113.9	0.63
Longford	39 14 34.59	75 59 38.98	47 13 49	Primrose, (2)	227 12 48	3152.8	3447.8	1.96
			61 15 56	Wallis	241 15 11	1991.3	2177.6	1.24
Double Creek Point	39 14 10.41	75 59 09.28	88 43 11	Opossum Point	268 42 32	1455.8	1592.0	0.91
			136 19 23	Longford	316 19 04	1031.0	1127.5	0.64
Double Creek Marsh	39 14 31.18	75 58 34.15	73 40 55	Opossum Point	253 39 54	2394.5	2618.6	1.49
			52 45 44	Double Creek Point	232 45 22	1058.3	1157.3	0.65
Walker	39 14 46.72	75 58 42.69	29 40 24	Double Creek Point	209 40 07	1288.5	1409.1	0.80
			336 52 08	Double Creek Marsh	156 52 13	520.9	569.7	0.32
Muddy Marsh	39 14 50.17	75 57 42.47	59 38 45	Double Creek Marsh	239 38 19	1158.2	1266.6	0.72
			84 57 38	Walker	264 57 07	1208.7	1321.8	0.75
Beckington's Marsh	39 14 32.44	75 57 49.67	109 06 46	Walker	289 06 13	1345.6	1471.5	0.84
			172 58 24	Muddy Marsh	352 58 22	550.8	602.4	0.34
Thomson's Marsh	39 14 20.57	75 57 00.94	126 27 41	Muddy Marsh	306 27 08	1536.0	1679.7	0.96
			107 24 02	Beckington's Marsh	287 23 31	1224.0	1338.5	0.76

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Sprigg	39 14 33.11	75 36 32.11	89 22 11	Beckington's Marsh	269 21 22	1859.4	2033.4	1.16
			60 47 14	Thomson's Marsh	240 46 56	792.1	866.2	0.49
Sutton	39 14 11.80	75 55 54.95	103 02 30	Beckington's Marsh	283 01 17	2823.3	3087.5	1.75
			126 24 49	Sprigg	306 24 25	1107.4	1211.0	0.69
Brewer's Point	39 14 28.15	75 55 41.56	97 12 49	Sprigg	277 12 17	1221.8	1336.1	0.76
			32 29 29	Sutton	212 29 21	597.5	653.4	0.37
Slaughter	39 14 41.49	75 54 52.00	58 46 02	Sutton	238 45 22	1765.4	1930.6	1.10
			70 54 14	Brewer's Point	250 53 42	1257.7	1375.4	0.78
Owen	39 14 34.73	75 54 17.80	84 14 36	Brewer's Point	264 13 43	2018.7	2207.6	1.26
			104 17 21	Slaughter	284 17 00	846.2	925.4	0.53
Kirby	39 14 47.06	75 53 11.91	85 55 15	Slaughter	265 54 13	2405.9	2631.0	1.49
			76 28 13	Owen	256 27 31	1624.9	1777.0	1.01
Kent Island and opposite shore.								
Kent Island, (1)	39 01 49.35	76 18 46.78	195 02 33	Swan Point	15 04 00	12698.7	13886.9	7.89
			141 21 59	Bodkin	321 17 58	14713.4	16090.1	9.14
Mezick	39 01 00.83	76 23 24.42	169 01 28	Bodkin	349 00 22	13226.7	14464.2	8.22
			257 20 49	Kent Island, (1)	77 23 44	6843.9	7484.3	4.25
Sandy Point	39 01 07.51	76 23 28.45	169 16 14	Bodkin	349 15 10	13006.2	14223.2	8.08
			259 11 31	Kent Island, (1)	79 14 28	6896.9	7542.2	4.29
Kent Island, (2)	38 58 21.48	76 20 21.98	149 09 20	Gibson's Island	329 06 15	13468.8	14729.1	8.37
			199 39 23	Kent Island, (1)	19 40 23	6806.8	7443.7	4.23

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Kent Island, (3)	38 57 02.03	76 21 08.94	157 35 45	Gibson's Island	337 33 11	15156.4	16574.6	9.42
			201 06 09	Kent Island, (1)	21 07 39	9496.6	10385.2	5.90
Thomas' Point	38 54 25.09	76 26 52.07	232 54 02	North Base	52 58 16	12179.7	13319.4	7.57
			278 01 47	South Base	98 05 04	7609.4	8321.4	4.73
Hackett's Point	38 59 02.82	76 25 09.22	240 47 55	Kent Island, (1)	60 51 51	10537.3	11523.3	6.55
			16 09 13	Thomas' Point	196 08 13	8912.9	9746.9	5.54
Price's Point	38 54 29.21	76 21 39.36	149 05 52	Hackett's Point	329 03 40	9834.5	10754.7	6.11
			89 04 52	Thomas' Point	269 01 36	7536.9	8242.1	4.68
Bloody Point	38 50 52.47	76 22 29.72	136 03 36	Thomas' Point	316 00 51	9108.4	9960.7	5.66
			192 27 58	South Base	12 28 30	5622.2	6148.3	3.49
Greenbury's Point	38 58 21.79	76 26 56.12	313 12 21	Price's Point	133 15 40	10469.7	11449.4	6.51
			243 48 02	Hackett's Point	63 49 09	2867.0	3135.3	1.78
Tallis' Point	38 56 20.71	76 26 44.00	3 09 28	Thomas' Point	183 09 23	3567.6	3901.4	2.22
			295 04 36	Price's Point	115 07 47	8103.0	8861.2	5.04
Annapolis State-house	38 58 40.18	76 29 09.41	248 39 59	Kent Island, (1)	68 46 31	16075.4	17579.6	9.99
			305 29 31	Price's Point	125 34 14	13317.5	14563.6	8.27
Magothy and Severn Rivers.								
LINSTID	39 05 18.39	76 28 49.96	....	....	....	....	....	....
Persimon Point	39 02 51.88	76 25 58.89	200 18 52	Gibson's Island	20 19 23	3435.9	3757.4	2.14
			137 42 28	Linstid	317 40 41	6108.8	6680.4	3.79

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Pettibone	39 02 25.08	76 24 44.55	171 39 24	Gibson's Island	351 39 09	4092.1	4475.0	2.54
			114 49 36	Persimon Point	294 48 49	2479.3	2711.1	1.54
Stony Point	39 04 06.71	76 25 45.44	7 58 57	Persimon Point	187 58 48	2329.9	2547.9	1.45
			334 57 39	Pettibone	154 58 17	3457.4	3780.9	2.15
Hickory Point	39 05 16.83	76 27 09.75	91 09 29	Linstid	271 08 26	2408.6	2634.0	1.49
			339 08 04	Persimon Point	159 08 49	4782.9	5230.4	2.97
Strawberry Plains	39 03 14.54	76 29 42.62	198 20 09	Linstid	18 20 42	4023.0	4399.4	2.50
			224 14 59	Hickory Point	44 16 37	5264.8	5757.4	3.27
Aisquith Hill	39 02 37.32	76 30 53.79	210 55 43	Linstid	30 57 01	5790.1	6331.9	3.60
			236 08 55	Strawberry Plains	56 09 39	2060.5	2253.3	1.28
Shop Hill	39 02 58.16	76 34 23.00	241 36 02	Linstid	61 39 32	9098.3	9949.6	5.65
			277 15 57	Aisquith Hill	97 18 09	5071.3	5545.8	3.15
Brewer's Hill	39 01 32.69	76 31 46 07	212 14 56	Aisquith Hill	32 15 29	2356.5	2578.9	1.47
			124 56 55	Shop Hill	304 55 17	4602.9	5033.6	2.86
Watkins, (1)	39 01 05.89	76 29 40.72	148 04 30	Aisquith Hill	328 03 44	3322.1	3632.9	2.06
			105 20 29	Brewer's Hill	285 19 10	3126.3	3418.8	1.94
Wells' Hill	38 59 35.62	76 30 15.61	196 46 59	Watkins, (1)	16 47 21	2907.2	3179.2	1.81
			148 55 34	Brewer's Hill	328 54 37	4215.0	4609.4	2.62
Brice's Point	38 59 49.58	76 28 46.90	151 11 12	Watkins, (1)	331 10 38	2685.8	2937.1	1.67
			78 36 51	Wells' Hill	258 35 55	2177.5	2381.3	1.35
Frog Pond Hill	38 57 00.16	76 29 22.61	165 06 31	Wells' Hill	345 05 58	4960.5	5424.7	3.08
			189 20 47	Brice's Point	9 21 09	5294.3	5789.7	3.29

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Beaumont	38 59 15.20	76 27 50.64	100 14 53	Well's Hill	280 13 21	3544.7	3876.4	2.20
			28 00 35	Frog Pond Hill	207 59 37	4716.0	5157.3	2.93
Ridout	39 00 22.90	76 25 52.18	337 21 29	Hackett's Point	187 21 56	2677.2	2927.7	1.66
			65 11 48	Taylor	245 10 42	2784.4	3044.9	1.73
Thompson's Hill	39 01 48.44	76 33 04.57	138 45 00	Shop Hill	318 44 10	2859.9	3127.5	1.78
			244 23 14	Aisquith Hill	64 24 36	3487.4	3813.7	2.17
Worthington	39 01 10.73	76 34 32.52	183 57 23	Shop Hill	3 57 29	3320.3	3631.0	2.06
			241 12 12	Thompson's Hill	61 13 08	2413.8	2639.7	1.50
Cooke's Bank	39 03 45.06	76 32 53.55	56 05 35	Shop Hill	236 04 38	2591.5	2834.0	1.61
			4 13 04	Thompson's Hill	184 12 58	3615.6	3953.9	2.25
Miller's Hill	39 03 04.10	76 31 57.89	34 30 57	Thompson's Hill	214 30 15	2830.8	3095.7	1.76
			354 14 55	Brewer's Hill	174 15 02	2832.8	3097.7	1.77
Mount Pleasant	39 02 26.87	76 35 01.21	255 23 09	Miller's Hill	75 25 04	4555.0	4981.2	2.83
			343 37 50	Worthington	163 38 08	2447.5	2676.5	1.52
South River.								
Horse-shoe Point	38 50 20.72	76 28 54.22	201 20 00	Thomas' Point	21 21 17	8090.0	8847.0	5.03
			263 56 23	Bloody Point	84 00 24	9323.3	10195.7	5.79
Sanders' Point	38 53 07.62	76 29 01.33	232 30 22	Thomas' Point	52 31 43	3925.2	4292.6	2.44
			358 05 32	Horse-shoe Point	178 05 36	5149.3	5631.1	3.20
Fishing Creek	38 54 39.46	76 27 51.49	287 11 40	Thomas' Point	107 12 17	1498.6	1638.8	0.93
			30 43 44	Sanders' Point	210 43 00	3294.0	3602.2	2.05

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Turkey Point	38 54 28.37	76 29 21.94	348 43 22	Sanders' Point	168 43 35	2538.8	2776.4	1.58
			261 04 32	Fishing Creek	81 05 29	2205.6	2412.0	1.37
Hill's Point	38 55 21.32	76 29 44.30	295 24 03	Fishing Creek	115 25 14	3008.4	3289.9	1.87
			341 44 23	Turkey Point	161 44 37	1719.3	1880.2	1.07
Deep Point	38 55 09.24	76 30 14.01	315 07 40	Turkey Point	135 08 13	1778.1	1944.5	1.11
			242 29 44	Hill's Point	62 30 03	806.8	882.3	0.50
Switcher's Point	38 55 51.36	76 30 39.03	305 05 50	Hill's Point	125 06 24	1610.9	1757.1	1.00
			335 07 05	Deep Point	155 07 20	1431.8	1565.8	0.87
Brewer's Point	38 55 53.44	76 31 21.77	309 52 02	Deep Point	129 52 45	2126.2	2325.2	1.32
			273 33 33	Switcher's Point	93 34 20	1031.3	1127.8	0.64
Ferry	38 56 40.95	76 31 37.52	317 20 37	Switcher's Point	137 21 15	2079.0	2273.5	1.29
			345 28 48	Brewer's Point	165 28 58	1513.2	1654.8	0.94
Gingawill Creek	38 56 59.67	76 32 28.76	321 41 21	Brewer's Point	141 42 04	2602.5	2846.0	1.62
			295 04 29	Ferry	115 05 02	1362.1	1489.6	0.84
Lee	38 56 45.08	76 32 56.10	273 50 35	Ferry	93 51 24	1896.3	2073.7	1.16
			235 38 13	Gingawill Creek	55 38 30	797.3	871.9	0.50
Tucker's Point	38 57 17.34	76 33 15.93	295 37 08	Gingawill Creek	115 37 38	1259.6	1377.5	0.78
			334 21 18	Lee	154 21 31	1103.4	1206.7	0.69
Holland's Point	38 56 59.97	76 33 31.86	298 03 59	Lee	118 04 22	975.8	1067.1	0.60
			215 36 27	Tucker's Point	35 36 37	658.7	720.3	0.41
Boyd's Point	38 57 14.64	76 33 46.78	263 36 18	Tucker's Point	83 36 37	747.3	817.2	0.47
			321 32 58	Holland's Point	141 33 07	577.5	631.5	0.36

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′	Metres.	Yards.	Miles.
Warehouse	38 57 09.60	76 34 02.58	291 53 23	Holland's Point	111 53 42	797.1	871.7	0.50
			247 49 08	Boyd's Point	67 49 18	410.8	494.3	0.26
Fox Den	38 57 33.51	76 34 24.11	302 55 27	Boyd's Point	122 55 50	1070.6	1170.8	0.67
			324 53 24	Warehouse	144 53 38	900.9	985.2	0.56
Gravelly Point	38 57 26.83	76 34 39.01	301 12 22	Warehouse	121 12 45	1025.3	1121.3	0.63
			240 09 10	Fox Den	60 09 19	413.5	452.2	0.25
Beard's Point	38 57 37.84	76 35 00.35	303 27 31	Gravelly Point	123 27 45	615.9	673.5	0.38
			278 42 48	Fox Den	98 43 11	882.7	965.3	0.55
Weedon	38 57 44.70	76 34 49.39	335 36 42	Gravelly Point	155 36 49	605.0	661.6	0.38
			51 18 38	Beard's Point	231 18 31	338.2	369.9	0.21
Old Woman Point	38 57 45.70	76 35 19.36	297 53 43	Beard's Point	117 53 54	517.7	566.2	0.32
			272 26 36	Weedon	92 26 55	722.1	789.7	0.45
Nicholson	38 57 43.50	76 35 29.83	283 49 36	Beard's Point	103 49 54	730.6	799.0	0.45
			254 58 16	Old Woman Point	74 58 23	260.7	285.1	0.16
Wood-landing	38 58 16.29	76 35 42.21	343 33 55	Nicholson	163 34 03	1053.9	1152.5	0.66
			329 45 06	Old Woman Point	149 45 20	1091.8	1194.0	0.68
West River.								
Gowan	38 52 55.90	76 29 10.42	230 28 15	Thomas' Point	50 29 42	4320.8	4725.1	2.68
			355 19 51	Horse-shoe	175 20 01	4800.8	5250.0	2.98
Cutts' Point	38 51 12.01	76 29 33.11	189 41 30	Gowan	9 41 44	3249.4	3553.4	2.02
			213 05 34	Thomas' Point	33 07 15	7106.8	7771.8	4.42

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Dutchman's Point	38 52 06.94	76 30 15.42	226 03 42	Gowan	46 04 23	2175.3	2378.9	1.35
			328 56 50	Cutts' Point	148 57 16	1977.0	2162.0	1.23
Cedar Point	38 51 01.14	76 31 07.59	261 37 29	Cutts' Point	81 38 28	2302.4	2517.8	1.43
			211 47 49	Dutchman's Point	31 48 22	2387.1	2610.5	1.48
Maxcy	38 51 07.28	76 31 53.94	267 31 48	Cutts' Point	87 33 16	3398.5	3716.5	2.11
			332 14 13	Dutchman's Point	52 15 15	3004.4	3285.5	1.87
Rhode River	38 52 09.25	76 30 51.90	312 53 27	Cutts' Point	132 54 17	2592.6	2835.2	1.61
			274 36 49	Dutchman's Point	94 37 12	882.3	964.9	0.56
Marriott	38 52 24.15	76 36 16.41	....	....	....	....	....	....
Poplar Island, Herring Bay.								
Poplar Island, (1)	38 45 25.66	76 22 53.29	....	....	....	....	....	....
Franklin's Point	38 49 02.61	76 29 30.91	231 58 34	South Base	52 03 29	14423.8	15773.4	8.96
			201 02 56	Thomas' Point	21 04 35	10655.3	11652.3	6.62
Poplar Island, (2)	38 46 23.23	76 22 57.02	159 08 25	Thomas' Point	339 05 57	15902.0	17390.0	9.88
			117 22 33	Franklin's Point	297 18 27	10699.6	10700.8	6.65
Holland's Point North	38 43 42.52	76 31 12.42	193 55 47	Franklin's Point	13 56 51	10170.1	11121.7	6.32
			255 10 58	Poplar Island, (1)	75 16 10	12465.4	13631.8	7.75
Paca's Island	38 46 30.91	76 31 51.01	349 48 49	Holland's Point North	169 49 13	5274.6	5768.1	3.28
			271 00 22	Poplar Island, (2)	91 05 56	12890.7	14096.9	8.01
Weems' Windmill	38 46 10.43	76 34 00.16	258 32 12	Paca's Island	78 33 33	3180.7	3478.3	1.98
			318 22 09	Holland's Point North	138 23 54	6099.5	6670.2	3.79

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Fairhaven	38 45 12.64	76 33 35.42	308 47 55	Holland's Point North	128 49 24	4432.7	4847.5	2.76
			226 14 08	Paca's Island	46 15 13	3489.6	3816.1	2.17
Owens' Windmill	38 42 59.53	76 32 49.15	192 09 17	Paca's Island	12 09 53	6666.9	7290.7	4.14
			164 46 40	Fairhaven	344 46 11	4253.3	4651.3	2.64
Holland's Point	38 42 53.42	76 31 12.30	192 07 34	Franklin's Point	12 08 38	11644.3	12733.9	7.24
			248 40 40	Poplar Island, (1)	68 45 52	12932.3	14142.4	8.04
Eastern Bay.								
Wade's Point	38 49 37.78	76 17 43.01	123 50 49	Thomas' Point	303 45 04	15927.1	17417.4	9.90
			43 56 57	Poplar Island, (1)	223 53 43	10793.8	11803.8	6.71
Poplar Island, (3)	38 46 50.21	76 22 04.74	230 41 27	Wade's Point	50 44 11	8158.6	8922.0	5.07
			153 44 18	Thomas' Point	333 41 17	15643.3	17107.0	9.72
Lowe's Point	38 46 35.99	76 19 45.77	207 50 54	Wade's Point	27 52 11	6339.1	6932.3	3.94
			97 27 35	Poplar Island, (3)	277 26 08	3382.2	3698.7	2.10
Long Point, (Kent Island)	38 51 13.56	76 19 56.58	20 51 09	Poplar Island, (3)	200 49 49	8688.7	9501.7	5.40
			312 30 45	Wade's Point	132 32 09	4370.7	4779.7	2.72
Turkey Point	38 54 04.79	76 17 14.77	4 43 46	Wade's Point	184 43 28	8262.1	9035.2	5.13
			36 28 00	Long Point, (Kent Island)	216 26 19	6563.2	7177.3	4.08
Bodkin Island	38 53 38.89	76 16 30.16	13 17 41	Wade's Point	193 16 55	7639.8	8354.7	4.75
			48 00 35	Long Point, (Kent Island)	227 58 25	6695.9	7322.4	4.16
Tilghman's Point	38 51 51.69	76 14 50.74	80 58 07	Long Point, (Kent Island)	260 54 55	7466.3	8164.9	4.64
			144 04 19	Bodkin Island	324 03 17	4082.8	4464.8	2.54

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Parson's Point	38 55 19.34	76 15 08.31	32 29 34	Bodkin Island	212 28 43	3671.6	4015.2	2.28
			356 12 58	Tilghman's Point	176 13 09	6416.8	7017.2	3.98
Parson's Island	38 54 01.85	76 14 54.95	358 33 08	Tilghman's Point	178 33 11	4014.6	4390.3	2.49
			72 51 18	Bodkin Island	252 50 18	2401.1	2625.8	1.49
Bryan	38 55 53.50	76 12 30.40	54 19 18	Bodkin Island	234 16 47	7112.4	7777.9	4.42
			24 24 30	Tilghman's Point	204 23 02	8187.0	8953.1	5.09
Wye River.								
Bennett's Point	38 51 47.82	76 11 47.88	116 44 49	Bodkin Island	296 41 52	7616.9	8329.6	4.73
			91 34 02	Tilghman's Point	271 32 07	4409.7	4822.3	2.74
Mouth of Wye River	38 50 37.68	76 11 35.00	115 49 33	Tilghman's Point	295 47 30	5242.0	5732.5	3.26
			171 49 59	Bennett's Point	351 49 51	2185.0	2389.5	1.36
E. Lloyd	38 51 23.88	76 09 43.44	103 50 15	Bennett's Point	283 48 57	3089.6	3379.0	1.92
			62 06 23	Mouth of Wye River	242 05 13	3043.9	3328.7	1.89
M. Lloyd	38 52 39.61	76 09 15.10	41 54 32	Mouth of Wye River	221 53 04	5050.6	5523.2	3.14
			16 18 34	E. Lloyd	196 18 16	2432.8	2660.5	1.51
White House, (1)	38 52 13.14	76 08 00.38	58 34 31	E. Lloyd	238 33 26	2911.8	3184.3	1.81
			114 23 32	M. Lloyd	294 22 45	1977.4	2162.4	1.21
White House, (2)	38 52 42.83	76 08 23.15	85 28 31	M. Lloyd	265 27 58	1256.2	1373.7	0.78
			329 04 00	White House, (1)	149 04 14	1067.5	1167.4	0.66
White House, (3)	38 52 27.55	76 07 33.90	55 09 24	White House, (1)	235 09 08	777.8	850.6	0.48
			111 39 34	White House, (2)	291 39 04	1277.1	1396.6	0.79

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Paca	38 52 59.18	76 06 47.34	77 43 53	White House, (2)	257 42 53	2363.0	2584.1	1.47
			49 03 15	White House, (3)	229 02 45	1485.7	1624.7	0.92
Daniel Lloyd, (1)	38 52 26.00	76 06 44.01	92 21 43	White House, (3).	272 21 11	1203.5	1316.1	0.75
			175 30 43	Paca	355 30 41	1026.4	1122.4	0.64
Daniel Lloyd, (2)	38 52 37.65	76 06 24.78	140 40 54	Paca	320 40 40	858.2	938.5	0.53
			52 12 51	Daniel Lloyd, (1)	232 12 39	586.5	641.4	0.37
Daniel Lloyd, (3)	38 52 39.37	76 05 59.35	117 50 47	Paca	297 50 17	1308.2	1430.6	0.81
			69 02 42	Daniel Lloyd, (1)	249 02 14	1152.8	1260.7	0.72
Wye Landing	38 53 08.16	76 05 41.36	26 01 39	Daniel Lloyd, (3)	206 01 48	987.7	1080.1	0.61
			48 03 29	Daniel Lloyd, (2)	228 03 02	1406.9	1538.5	0.87
St. Michael's River.								
Fairview	38 48 08.12	76 11 43.53	146 47 46	Tilghman's Point	326 45 48	8240.2	9011.2	5.12
			182 33 29	Mouth of Wye	2 33 34	4615.9	5047.8	2.87
Deep Water Point	38 48 21.65	76 12 29.42	197 22 41	Mouth of Wye	17 23 15	4394.9	4806.1	2.73
			290 38 15	Fairview	110 38 44	1183.2	1294.0	0.73
Herring Island	38 50 02.67	76 12 40.62	235 41 57	Mouth of Wye	55 42 38	1915.6	2094.9	1.19
			338 42 00	Fairview	158 42 36	3790.9	4145.6	2.36
Little Neck Point	38 46 30.61	76 11 36.73	176 52 56	Fairview	356 52 52	3011.0	3292.7	1.87
			159 38 02	Deep Water Point	339 37 29	3652.1	3993.8	2.27
Loockerman	38 45 23.52	76 09 42.54	143 45 56	Deep Water Point	323 44 11	6810.8	7447.9	4.23
			126 54 08	Little Neck Point	306 52 56	3446.5	3769.0	2.14

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Long Point, (2)	38 46 08.63	76 10 05.04	107 02 28	Little Neck Point	287 01 31	2314.7	2531.3	1.44
			338 40 09	Loockerman	158 40 24	1493.2	1632.9	0.93
Sandy Point	38 46 42.59	76 08 45.57	29 26 04	Loockerman	209 25 28	2799.2	3061.1	1.74
			61 22 51	Long Point, (2)	241 22 01	2185.4	2389.9	1.36
Perry Hall	38 46 14.11	76 08 58.58	83 59 56	Long Point, (2)	263 59 14	1613.2	1764.2	1.00
			199 40 29	Sandy Point	19 40 37	932.6	1019.9	0.58
Bartlett	38 46 59.40	76 08 06.17	61 25 10	Sandy Point	241 24 45	1083.0	1184.3	0.67
			42 10 48	Perry Hall	222 10 15	1884.2	2060.5	1.17
Lowndes	38 47 30.11	76 08 03.38	34 48 08	Sandy Point	214 47 41	1784.2	1951.2	1.11
			4 04 03	Bartlett	184 04 01	949.4	1038.2	0.59
Goldsborough	38 47 43.94	76 06 50.71	55 42 03	Sandy Point	235 40 51	3355.7	3669.7	2.09
			76 20 26	Lowndes	256 19 40	1804.6	1973.5	1.12
Chesapeake Bay, Choptank River.								
BLAKE	38 39 41.88	76 31 55.79	....	....	....	....	....	....
HILL'S POINT	38 34 04.14	76 18 37.26	....	....	....	....	....	....
WILSON	38 26 18.29	76 26 39.38	....	....	....	....	....	....
Tilghman's Island	38 39 59.45	76 20 23.62	346 46 28	Hill's Point	166 47 35	11253.1	12306.1	6.99
			88 12 20	Blake	268 05 07	16741.1	18307.6	10.40
Sharpe's Island, (1)	38 37 27.02	76 21 25.80	20 14 53	Wilson	200 11 38	21972.8	24028.6	13.65
			326 53 01	Hill's Point	146 54 46	7466.7	8165.4	4.64

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Cooke's Point	38 37 59.53	76 17 21.04	80 24 28	Sharpe's Island, (1)	260 21 55	6003.7	6565.5	3.73
			14 15 50	Hill's Point	194 15 03	7488.2	8188.9	4.65
Nelson's Point	38 41 51.61	76 15 41.52	63 07 54	Tilghman's Island	243 04 58	7644.9	8360.2	4.75
			18 35 32	Cooke's Point	198 34 30	7549.1	8255.5	4.69
Harris Creek	38 43 00.43	76 19 12.83	343 45 11	Cooke's Point	163 46 21	9662.8	10567.0	6.01
			292 33 06	Nelson's Point	112 35 18	5528.5	6045.8	3.44
Royston's Island	38 41 31.09	76 13 39.13	39 27 17	Cooke's Point	219 24 58	8445.6	9235.9	5.23
			102 05 04	Nelson's Point	282 03 47	3024.4	3307.5	1.88
Skinner	38 43 55.69	76 15 13.40	10 04 11	Nelson's Point	190 03 53	3885.7	4249.3	2.42
			332 55 59	Royston's Island	152 56 58	5006.5	5475.0	3.11
Hambleton's Island	38 44 52.82	76 13 33.90	28 53 48	Nelson's Point	208 52 28	6381.4	6978.5	3.97
			53 45 48	Skinner	233 44 46	2979.4	3258.2	1.85
Todd's Point	38 37 53.34	76 13 53.82	92 12 03	Cooke's Point	272 09 53	5015.1	5484.4	3.11
			160 29 48	Nelson's Point	340 28 40	7794.1	8523.4	4.81
Benoni's Point	38 40 10.36	76 11 44.28	118 35 19	Nelson's Point	298 32 50	6528.0	7138.8	4.06
			36 33 44	Todd's Point	216 32 23	5259.1	5751.2	3.27
Castle Haven	38 37 43.44	76 09 57.28	93 04 26	Todd's Point	273 01 59	5728.7	6264.8	3.56
			150 16 42	Benoni's Point	330 15 36	5216.7	5704.8	3.24
Bachelor's Point	38 40 13.22	76 10 08.14	87 50 04	Benoni's Point	267 49 04	2325.5	2543.1	1.45
			356 44 40	Castle Haven	176 44 46	4625.6	5058.4	2.87
Glory Point	38 38 11.03	76 08 36.37	129 01 05	Benoni's Point	308 59 08	5846.0	6393.0	3.63
			66 30 24	Castle Haven	246 29 33	2133.7	2333.4	1.33

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Howell's Point	38 36 43.06	76 06 27.08	129 49 59	Benoni's Point	309 46 41	9984.2	10918.4	6.20
			110 07 49	Castle Haven	290 05 37	5414.3	5920.9	3.37
Horn Point	38 36 18.49	76 08 07.68	134 39 51	Castle Haven	314 38 42	3726.6	4075.3	2.32
			252 42 16	Howell's Point	72 43 19	2548.9	2787.4	1.59
Hambrook's Point	38 35 31.30	76 05 00.27	136 30 10	Howell's Point	316 29 16	3050.9	3336.4	1.90
			107 48 43	Horn Point	287 46 46	4762.3	5207.9	2.96
Porpoise Creek	38 36 15.58	76 03 04.10	99 48 51	Howell's Point	279 46 45	4983.3	5449.7	3.10
			64 06 32	Hambrook's Point	244 05 20	3124.8	3417.3	1.94
Tate's Bank	38 33 39.50	76 02 24.66	132 28 58	Hambrook's Point	312 27 21	5105.3	5583.1	3.17
			168 47 21	Porpoise Creek	348 46 56	4905.7	5364.7	3.05
Chancellor's Point	38 34 41.48	76 01 20.31	106 07 10	Hambrook's Point	286 04 53	5540.1	6058.5	3.44
			39 11 36	Tate's Bank	219 10 56	2465.2	2695.9	1.53
Sand Hill	38 35 06.27	76 05 58.48	166 57 09	Howell's Point	346 56 51	3063.5	3350.2	1.91
			125 28 41	Horn Point	305 27 20	3838.1	4197.3	2.38
Reid	38 36 49.55	76 04 37.78	85 41 15	Howell's Point	265 40 07	2651.7	2899.8	1.65
			12 43 01	Hambrook's Point	192 42 47	2473.2	2704.6	1.54
Oystershell Point	38 34 45.53	75 59 26.41	64 45 34	Tate's Bank	244 43 43	4770.8	5217.2	2.97
			87 25 05	Chancellor's Point	267 23 54	2759.6	3017.8	1.72
Waggaman	38 34 13.96	76 00 09.42	72 02 24	Tate's Bank	252 01 00	3441.7	3763.7	2.14
			116 19 34	Chancellor's Point	296 18 50	1914.3	2093.4	1.19
Goose Point	38 35 40.20	75 59 43.98	52 10 49	Chancellor's Point	232 09 49	2951.6	3227.8	1.83
			13 02 28	Waggaman	193 02 12	2729.3	2984.7	1.70

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Stewart	38 35 41.93	75 58 21.36	42 09 49	Oystershell Point	222 09 08	2345.6	2565.1	1.46
			88 28 43	Goose Point	268 27 51	1999.9	2187.0	1.24
Warwick	38 36 53.77	75 58 09.42	45 15 19	Goose Point	225 14 20	3221.8	3523.3	2.00
			7 26 07	Stewart	187 26 00	2233.7	2442.7	1.39
Jamaica Point	38 36 36.29	75 58 53.34	243 05 34	Warwick	63 06 01	1191.3	1302.8	0.74
			35 19 38	Goose Point	215 19 06	2119.5	2317.9	1.32
Case	38 37 35.09	75 59 16.21	339 10 38	Stewart	159 11 13	2732.6	2988.3	1.70
			308 15 21	Warwick	128 16 03	2057.2	2249.7	1.28
Small	38 38 20.35	75 58 19.72	354 40 25	Warwick	174 40 31	2680.9	2931.8	1.67
			44 24 02	Case	224 23 26	1952.9	2135.6	1.21
Cabin Creek	38 37 48.97	75 57 38.88	79 42 35	Case	259 41 34	2392.4	2616.3	1.49
			134 25 24	Small	314 24 59	1382.6	1512.7	0.86
Jacob	38 38 55.37	75 56 44.48	64 53 31	Small	244 52 32	2543.6	2781.6	1.58
			32 44 02	Cabin Creek	212 43 28	2433.7	2661.4	1.51
Hunting Creek	38 40 11.35	75 56 26.48	38 40 22	Small	218 39 12	4382.7	4792.9	2.72
			10 31 39	Jacob	190 31 28	2382.6	2605.6	1.48
Barnes	38 39 59.97	75 57 10.89	342 13 43	Jacob	162 13 59	2091.8	2287.5	1.30
			251 54 51	Hunting Creek	71 55 18	1129.3	1235.0	0.70
Goldsborough	38 41 02.64	75 57 05.16	329 24 51	Hunting Creek	149 25 15	1837.3	2009.2	1.14
			4 06 12	Barnes	184 06 09	1937.2	2118.5	1.20
Ross	38 41 05.07	75 58 16.08	302 00 48	Hunting Creek	122 01 56	3124.1	3416.5	1.94
			272 29 45	Goldsborough	92 30 29	1715.5	1876.0	1.06

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Frazer	38 42 13.27	75 58 58.07	308 35 27	Goldsborough	128 36 37	2490.8	2723.8	1.55
			334 14 34	Ross	154 15 00	2334.9	2553.4	1.45
Lloyd	38 42 02.67	75 59 38.05	311 52 28	Ross	131 53 19	2660.4	2909.3	1.65
			251 17 57	Frazer	71 18 22	1019.9	1115.3	0.63
Malone	38 43 04.58	76 00 28.66	305 51 27	Frazer	125 52 24	2700.4	2953.1	1.68
			327 21 43	Lloyd	147 22 15	2266.9	2479.0	1.41
Hog Island	38 43 53.60	75 59 47.86	356 02 36	Lloyd	176 02 43	3428.7	3749.5	2.13
			33 06 52	Malone	213 06 27	1804.5	1973.4	1.12
Stevens	38 44 26.75	76 00 13.11	8 26 14	Malone	188 26 04	2561.2	2800.9	1.59
			329 10 21	Hog Island	149 10 36	1190.2	1301.6	0.74
Cook	38 44 51.03	75 59 13.19	25 19 00	Hog Island	205 18 38	1958.5	2141.8	1.22
			62 39 35	Stevens	242 38 58	1629.2	1781.6	1.01
Dover	38 45 30.42	75 59 28.03	29 00 59	Stevens	209 00 31	2244.6	2454.6	1.40
			343 33 33	Cook	163 33 42	1266.3	1384.8	0.79
Willis	38 45 28.83	75 58 46.54	28 54 15	Cook	208 53 58	1331.4	1456.0	0.83
			92 48 19	Dover	272 47 53	1003.0	1096.6	0.62
Kingstown	38 46 45.09	75 57 56.13	43 56 54	Dover	223 55 57	3197.3	3496.5	1.99
			27 22 13	Willis	207 21 42	2647.5	2895.2	1.65
Providence	38 46 13.04	75 57 46.66	61 46 22	Dover	241 45 19	2777.7	3037.6	1.74
			166 59 04	Kingstown	346 58 58	1014.1	1109.0	0.63
Sullivan	38 46 51.76	75 56 14.97	85 11 40	Kingstown	265 10 36	2450.0	2679.2	1.52
			61 39 59	Providence	241 39 01	2514.5	2749.8	1.56

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Clark	38 46 57.80	75 57 09.24	33 12 54	Providence	213 12 31	1649.1	1803.4	1.03
			278 04 51	Sullivan	98 05 25	1322.8	1446.6	0.82
Wing's Landing	38 47 14.49	75 55 40.28	50 05 00	Sullivan	230 04 38	1091.7	1193.9	0.68
			76 31 53	Clark	256 30 57	2207.6	2414.2	1.37
High Bank	38 47 29.57	75 55 53.09	24 23 03	Sullivan	204 22 49	1279.7	1399.4	0.80
			326 24 28	Wing's Landing	146 24 36	558.3	610.6	0.35
Third Haven Creek.								
Oxford	38 41 22.08	76 10 12.98	44 56 59	Benoni's Point	224 56 02	3123.9	3416.3	1.94
			356 51 06	Bachelor's Point	176 51 09	2126.2	2325.2	1.32
Battee	38 41 36.36	76 10 48.47	339 11 06	Bachelor's Point	159 11 28	2742.2	2998.8	1.70
			297 10 33	Oxford	117 10 55	963.9	1054.1	0.60
Tilghman	38 41 52.79	76 09 21.20	52 53 14	Oxford	232 52 42	1569.2	1716.0	0.98
			76 29 49	Battee	256 28 55	2168.7	2371.6	1.35
Morling	38 42 17.68	76 09 24.50	57 52 47	Battee	237 51 55	2395.7	2619.9	1.49
			354 04 19	Tilghman	174 04 21	7715.4	8437.3	4.79
Eagle Point	38 42 27.09	76 07 48.20	64 48 30	Tilghman	244 47 32	2483.4	2715.8	1.55
			82 54 16	Morling	262 53 16	2344.6	2564.0	1.46
Mare's Neck	38 42 35.80	76 08 44.85	33 31 38	Tilghman	213 31 15	1590.5	1739.3	0.99
			281 05 57	Eagle Point	101 06 32	1394.6	1525.1	0.87
Hambleton	38 43 05.99	76 08 08.17	338 05 32	Eagle Point	158 05 44	1292.7	1413.7	0.81
			43 35 37	Mare's Neck	223 35 14	1285.1	1405.4	0.80

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Diamond Hall	38 43 33.01	76 08 25.75	14 39 37	Mare's Neck	194 39 25	1823.3	1993.9	1.13
			232 59 28	Hambleton	152 59 39	935.1	1022.6	0.58
Long Point	38 44 02.99	76 07 54.22	10 40 51	Hambleton	190 40 46	1819.6	1989.9	1.13
			38 34 57	Diamond Hall	218 34 38	1221.6	1335.9	0.76
Dr. Clough	38 43 45.86	76 07 56.11	61 03 26	Diamond Hall	241 03 08	818.2	894.8	0.51
			184 41 08	Long Point	4 41 09	560.8	613.2	0.35
Haywood	38 43 59.85	76 07 03.46	95 56 52	Long Point	275 56 20	1232.4	1347.7	0.77
			71 16 01	Dr. Clough	251 15 28	1342.8	1468.5	0.83
Cedar Point	38 44 34.11	76 06 42.21	61 53 57	Long Point	241 53 11	1971.4	2155.9	1.23
			25 54 46	Haywood	205 54 32	1174.4	1284.3	0.73
Neck Point	38 44 35.84	76 07 05.76	357 08 18	Haywood	177 08 19	1110.9	1214.9	0.69
			275 20 36	Cedar Point	95 20 51	571.1	624.5	0.36
Bartlett	38 45 16.95	76 06 49.37	352 32 36	Cedar Point	172 32 41	1332.1	1456.8	0.83
			17 20 14	Neck Point	197 20 04	1328.0	1452.3	0.82
Watermelon Point	38 45 01.85	76 06 43.23	34 09 23	Neck Point	214 09 09	969.0	1059.7	0.60
			162 20 24	Bartlett	342 20 20	488.8	534.6	0.31
Holliday	38 45 43.25	76 06 07.87	51 01 18	Bartlett	231 00 52	1289.0	1409.7	0.80
			33 46 31	Watermelon Point	213 46 09	1535.8	1679.5	0.96
Hudson River, (Little Choptank.)								
James' Point	38 31 54.36	76 19 49.71	203 39 51	Hill's Point	23 40 36	4369.1	4777.9	1.77
			167 14 02	Sharpe's Island, (1)	347 13 02	10516.8	11500.9	6.53

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Hooper's Point	38 30 19.53	76 16 51.60	159 43 59	Hill's Point	339 42 53	7382.8	8073.7	4.59
			124 08 34	James' Point	304 06 43	5211.4	5699.0	3.24
Ragged Point	38 31 44.04	76 16 12.28	93 28 34	James' Point	273 26 19	5275.3	5768.9	3.28
			20 05 08	Hooper's Point	200 04 43	2774.3	3033.9	1.73
Susquehanna Point	38 31 19.36	76 14 36.98	60 30 53	Hooper's Point	240 29 29	3746.7	4097.3	2.33
			108 15 09	Ragged Point	288 14 10	2430.2	2657.6	1.51
McKeel's Point	38 32 16.90	76 13 08.49	77 11 49	Ragged Point	257 09 55	4564.9	4992.0	2.84
			50 23 59	Susquehanna Point	230 23 04	2782.0	3042.3	1.73
Hudson's Creek	38 32 37.74	76 14 10.76	14 43 44	Susquehanna Point	194 43 28	2498.4	2732.2	1.55
			293 04 34	McKeel's Point	113 05 13	1639.2	1792.6	1.02
Cedar Point	38 33 00.88	76 12 59.87	8 45 08	McKeel's Point	188 45 02	1372.0	1501.0	0.85
			67 26 23	Hudson's Creek	247 25 38	1858.9	2032.8	1.16
Skinner	38 33 08.35	76 12 00.34	46 08 21	McKeel's Point	226 07 38	2289.0	2503.2	1.42
			80 55 47	Cedar Point	260 55 10	1459.7	1596.3	0.91
Solomon's Cove	38 33 36.37	76 11 27.99	63 49 15	Cedar Point	243 48 18	2479.1	2711.1	1.54
			42 12 13	Skinner	222 11 53	1166.0	1274.9	0.72
Patterson	38 33 33.99	76 10 11.21	73 21 31	Skinner	253 20 23	2757.7	3015.8	1.71
			92 16 27	Solomon's Cove	272 15 39	1860.1	2034.2	1.15
Chesapeake Bay								
Plum Point	38 37 29.08	76 30 40.81	252 41 22	Tilghman's Island	72 47 47	15627.0	17089.2	9.71
			175 39 05	Holland's Point	355 38 45	10029.4	10967.8	6.23

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Chew	38 40 20.29	76 31 32.28	272 13 08	Tilghman's Island	92 20 06	16175.4	17688.9	10.05
			346 43 49	Plum Point	166 44 22	5423.2	5930.6	3.37
Sharpe's Island, (2)	38 36 39.17	76 22 07.84	339 08 46	James' Point	159 10 12	2848.2	3114.7	1.77
			18 59 04	Wilson	198 56 15	20241.3	22135.3	12.58
Sharpe's Island Light	38 37 43.75	76 21 55.23	104 07 55	Blake	284 01 40	14971.2	16372.1	9.30
			174 22 45	Poplar Island, (1)	354 22 09	14310.8	15649.9	8.89
Parran	38 32 50.28	76 30 43.45	262 33 20	Hill's Point	82 40 53	17727.3	19386.0	11.01
			333 54 17	Wilson	153 56 49	13455.0	14714.0	8.36
Dr. Dorsey	38 30 06.42	76 30 01.55	246 04 52	Hill's Point	66 11 58	18120.1	19815.6	11.26
			325 06 59	Wilson	145 09 05	8572.4	9374.5	5.33
James' Island	38 31 54.71	76 20 46.69	174 43 44	Sharpe's Island, (1)	354 43 19	10289.1	11251.9	6.39
			218 08 03	Hill's Point	38 09 24	50742.8	55490.8	31.53
S. Y. Dorsey	38 32 50.29	76 30 43.42	276 42 45	James' Island	96 48 57	14550.9	15912.4	9.04
			348 38 40	Dr. Dorsey	168 39 06	5153.2	5635.4	3.20
Bond	38 29 02.70	76 30 16.20	241 10 17	Hill's Point	61 17 32	19311.8	21118.8	12.00
			313 56 35	Wilson	133 58 50	7302.2	7985.5	4.54
Wilson, (2)	38 26 31.32	76 26 51.02	254 14 12	Taylor's Island	74 18 39	10833.1	11846.8	6.73
			221 29 43	James' Island	41 33 20	13318.0	14564.2	8.27
Taylor's Island	38 24 06.56	76 19 40.90	334 33 36	Meekin's Neck	154 35 27	10101.3	11046.5	6.28
			24 44 23	Cove Point	204 42 34	10159.6	11110.1	6.31
Travers	38 28 06.84	76 19 30.85	....	....	....	....	....	....

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
MEEKIN'S NECK	38 23 10.66	76 16 42.09	....	....	....	....	....	....
CALVERT	38 21 30.68	76 23 16.16	....	....	....	....	....	....
CEDAR POINT	38 17 54.09	76 21 42.77	....	....	....	....	....	....
Cove Point	38 23 07.24	76 22 36.10	204 42 20	Taylor's Island	24 44 09	10159.6	11110.3	6.31
			140 09 09	Dr. Dorsey	320 04 32	16843.1	18419.2	10.47
*Cove Point Light	38 23 06.60	76 22 36.40	18 05 00	Calvert	198 05 00	3104.0	3394.4	1.93
Barren Island	38 19 37.25	76 15 45.65	69 53 51	Cedar Point	249 50 09	9239.3	10103.8	5.74
			168 14 33	Meekin's Neck	348 13 58	6721.1	7350.0	4.18
Ponds	38 18 19.01	76 13 08.23	86 31 37	Cedar Point	266 26 18	12524.1	13696.0	7.78
			111 52 01	Calvert	291 45 44	15901.9	17389.8	9.88
Patuxent river.								
Hog Island	38 18 33.60	76 23 39.34	260 16 46	Barren Island	80 21 39	11671.5	12764.1	7.25
			293 15 36	Cedar Point	113 16 48	3082.5	3370.9	1.92
Slatt	38 19 41.95	76 24 46.47	270 35 13	Barren Island	90 40 48	13135.1	14364.2	8.16
			322 16 12	Hog Island	142 16 54	2663.7	2912.9	1.66
Carroll	38 18 13.82	76 24 43.70	248 40 41	Hog Island	68 41 21	1678.0	1835.0	1.04
			178 35 20	Slatt	358 35 18	2717.9	2972.2	1.69
Jones, (2)	38 19 33.15	76 25 15.20	248 45 32	Slatt	68 45 50	748.8	818.9	0.47
			342 37 44	Carroll	162 38 04	2562.6	2802.4	1.60

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Sandy Point	38 18 53.15	76 27 01.82	244 31 24	Jones, (2)	64 32 27	2868.3	3136.7	1.78
			289 51 21	Carroll	109 52 46	3567.4	3899.2	2.22
Woodyard	38 17 30.42	76 26 50.94	174 05 02	Sandy Point	354 04 55	2564.3	2804.2	1.60
			246 34 49	Carroll	66 36 08	3368.5	3683.7	2.09
Thomas	38 18 26.22	76 27 54.47	237 00 41	Sandy Point	57 01 13	1524.9	1667.6	0.95
			318 05 43	Woodyard	138 06 22	2311.5	2527.8	1.44
Town Point, (2)	38 19 12.18	76 28 21.97	286 45 43	Sandy Point	106 46 33	2033.4	2223.7	1.26
			324 48 40	Woodyard	144 49 37	3838.4	4197.6	2.39
Somerville	38 19 49.52	76 27 49.41	326 22 07	Sandy Point	146 22 37	2087.1	2282.4	1.30
			34 29 35	Town Point, (2)	214 29 15	1396.7	1527.4	0.87
Abell	38 19 50.60	76 29 15.54	270 54 18	Somerville	90 55 11	2092.1	2287.9	1.30
			212 18 38	Town Point, (2)	132 19 11	1759.5	1923.9	1.09
Hungerford	38 21 09.02	76 28 21.72	342 14 49	Somerville	162 15 09	2573.8	2814.6	1.60
			28 23 42	Abell	208 23 09	2748.5	3005.7	1.71
Gilliam	38 21 20.92	76 29 56.92	279 00 45	Hungerford	99 01 44	2340.0	2559.0	1.45
			312 17 55	Somerville	132 19 14	4186.6	4578.3	2.60
Petersen	38 23 28.71	76 30 05.76	329 36 28	Hungerford	149 37 32	4992.7	5459.9	3.10
			356 52 56	Gilliam	176 53 61	3945.7	4314.9	2.45
Setterly Point	38 22 48.47	76 31 42.62	302 08 36	Hungerford	122 10 40	5760.4	6299.4	3.58
			242 09 54	Petersen	62 10 54	2657.9	2907.1	1.65
St. Leonard's Creek	38 23 06.03	76 29 36.47	8 42 38	Gilliam	188 42 25	3278.3	3585.1	2.04
			134 32 18	Petersen	314 32 00	997.1	1090.4	0.62

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Brougham's Island	38 24 37.26	76 32 29.42	301 13 11	Petersen	121 14 40	4076.1	4457.5	2.53
			341 17 40	Setterly Point	161 18 09	3541.2	3872.6	2.20
High Bank	38 23 16.65	76 32 58.61	195 54 09	Brougham's Island	15 54 27	2584.3	2826.1	1.61
			264 55 06	Petersen	84 56 53	4210.7	4604.7	2.62
Barnes	38 25 25.41	76 34 12.61	300 39 35	Brougham's Island	120 40 39	2910.0	3182.3	1.81
			300 58 33	Petersen	121 01 07	6986.2	7636.9	4.34
Reeder	38 25 53.79	76 37 45.61	279 35 39	Barnes	99 37 52	5239.5	5729.8	3.26
			304 48 24	High Bank	124 51 23	8482.0	9275.7	5.27
Maud's Hill	38 24 38.93	76 36 03.67	241 58 55	Barnes	62 00 04	3051.5	3337.0	1.90
			133 02 08	Reeder	313 01 05	3382.4	3698.9	2.10
Ayres	38 26 01.87	76 35 14.65	24 56 28	Maud's Hill	204 55 58	2820.1	3084.0	1.75
			86 07 12	Reeder	266 05 38	3669.7	4013.7	2.28
McDaniell	38 28 08.41	76 39 23.38	330 15 41	Reeder	150 16 42	4780.0	5227.3	2.97
			302 52 50	Ayres	122 55 25	7182.4	7854.5	4.46
Duke	38 28 15.83	76 37 47.10	318 09 53	Ayres	138 11 28	5542.5	6061.1	3.44
			84 24 24	McDaniell	264 23 24	2344.9	2564.3	1.46
Holland Point	38 30 09.93	76 39 30.61	357 19 10	McDaniell	177 19 14	3750.8	4101.8	2.33
			324 30 03	Duke	144 31 08	4320.7	4725.0	2.68
Shirley Point	38 28 01.22	76 38 22.64	98 33 59	McDaniell	278 33 21	1488.9	1628.2	0.93
			240 23 22	Duke	62 23 44	972.1	1063.1	0.60
Washington	38 30 45.19	76 41 16.10	330 23 36	Reeder	150 25 47	10332.0	11298.8	6.42
			330 31 04	McDaniell	150 32 17	5551.9	6071.4	3.45

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
Honga River.	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Tom's Point	38 15 37.94	76 10 54.48	....	....	....	....	....	....
Ben's Point	38 18 46.41	76 13 03.57	331 37 29	Tom's Point	151 38 49	6603.3	7221.2	4.10
			82 45 27	Cedar Point	262 40 05	12715.9	13905.7	7.90
Johnson	38 18 37.00	76 07 58.45	92 16 02	Ben's Point	272 12 53	7418.1	8112.2	4.61
			37 47 17	Tom's Point	217 45 28	6984.1	7637.6	4.34
Smoke Point	38 17 37.01	76 11 16.61	248 58 07	Johnson	69 00 10	5157.8	5640.4	3.21
			129 28 37	Ben's Point	309 27 31	3366.1	3681.1	2.09
Crabb Point	38 15 13.68	76 05 51.03	119 12 39	Smoke Point	299 09 17	9062.7	9910.7	5.63
			153 43 52	Johnson	233 42 33	6991.2	7645.4	4.34
Hickory Point	38 16 05.55	76 10 10.36	284 12 43	Crabb Point	104 15 23	6503.4	7111.9	4.04
			214 27 48	Johnson	34 29 10	5664.2	6194.2	3.52
Long Ridge	38 13 52.58	76 08 16.05	145 52 56	Hickory Point	325 51 45	4952.4	5415.8	3.08
			234 38 58	Crabb Point	54 40 28	4323.1	4727.6	2.69
Windmill	38 16 28.61	76 08 38.41	72 21 17	Hickory Point	252 20 20	2345.3	2564.8	1.46
			299 34 33	Crabb Point	119 36 16	4678.5	5116.3	2.91
Hickory Cove	38 15 22.85	76 09 54.43	222 20 32	Windmill	42 21 19	2743.3	3000.0	1.71
			272 42 51	Crabb Point	92 45 22	5923.8	6478.1	3.68
Old Town Point	38 18 56.59	76 09 46.41	86 16 06	Ben's Point	266 14 04	4799.5	5248.6	2.98
			340 05 38	Windmill	160 06 20	4851.8	5305.8	3.01

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Wheatley	38 19 53.83	76 11 06.18	3 26 54	Smoke Point	183 26 48	4226.1	4621.5	2.63
			330 25 24	Windmill	150 26 56	7274.0	7954.6	4.52
Bar Neck	38 21 39.40	76 11 22.66	24 41 28	Ben's Point	204 40 25	5869.6	6418.8	3.65
			352 59 24	Wheatley	172 59 34	3279.1	3585.9	2.04
Fishing Creek	38 20 47.23	76 13 12.07	238 47 56	Bar Neck	58 49 03	3105.2	3395.8	1.93
			298 17 43	Wheatley	118 19 01	3472.2	3797.1	2.16
Hooper's Straits, Fishing Bay.								
HOLLAND	38 06 36.29	76 05 14.88	...	...	...	...	...	...
Bishop's Head	38 13 22.73	76 02 40.82	109 11 35	Tom's Point	289 06 30	12706.2	13895.1	7.90
			16 40 25	Holland	196 38 50	13079.6	14303.5	8.13
Turkey Point	38 09 54.02	75 56 41.51	64 02 51	Holland	243 57 34	13907.3	15218.7	8.64
			126 23 10	Bishop's Head	306 19 28	10854.9	11870.6	6.74
Bloodsworth	38 10 32.82	76 05 18.43	79 11 09	Point No Point	259 02 39	20467.3	22382.4	12.72
			359 19 21	Holland	179 19 23	7292.5	7974.9	4.35
Thomas	38 06 48.15	75 56 33.57	143 43 26	Bishop's Head	323 39 39	15095.6	16508.1	9.38
			88 23 42	Holland	268 18 20	12703.3	13892.5	7.89
Frank's Island	38 11 26.96	75 54 59.60	107 41 15	Bishop's Head	287 36 30	11773.9	12875.6	7.31
			14 54 45	Thomas	194 53 47	8894.6	9726.9	5.53
Piny Hammock	38 11 42.25	76 02 03.13	318 28 07	Thomas	138 31 30	12106.6	13239.4	7.52
			272 35 01	Frank's Island	92 39 22	10315.6	11280.8	6.41

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Sandy Island	38 14 38.49	75 56 04.71	58 05 47	Piny Hammock	238 02 05	10272.2	11233.4	6.38
			344 58 56	Frank's Island	164 59 36	6113.7	6685.8	3.80
Roseneer	38 17 01.32	76 01 37.73	3 35 40	Piny Hammock	183 35 24	9856.5	10778.8	6.12
			298 30 58	Sandy Island	118 34 24	9215.1	10077.4	5.73
Fishing Point	38 18 20.71	76 00 39.56	327 01 52	Frank's Island	147 05 22	15199.8	16622.1	9.44
			315 42 08	Sandy Island	135 44 58	9568.6	10463.9	5.95
Ragged Point	38 17 28.22	75 54 03.16	29 27 37	Sandy Island	209 26 21	6009.4	6571.7	3.73
			85 44 40	Roseneer	265 39 58	11077.2	12113.7	6.88
Wilson's Island	38 18 48.31	75 59 02.21	330 44 01	Sandy Island	150 45 51	8827.7	9653.9	5.49
			288 44 41	Ragged Point	108 47 46	7673.5	8391.5	4.77
Green's Island	38 20 31.66	75 54 23.29	355 03 25	Ragged Point	175 03 37	5676.7	6207.9	3.53
			64 49 54	Wilson's Island	244 47 01	7486.3	8168.8	4.65
Roaring Point	38 15 52.63	75 54 39.88	42 04 06	Sandy Island	222 03 14	3078.4	3366.5	1.91
			196 50 43	Ragged Point	16 51 06	3079.3	3367.4	1.91
Mulberry Island	38 16 21.71	75 55 58.95	233 54 28	Ragged Point	53 55 40	3481.7	3807.5	2.16
			2 31 17	Sandy Island	182 31 13	3185.3	3483.4	1.98
Snake Island	38 21 11.88	76 00 18.59	307 03 57	Ragged Point	127 07 50	11432.3	12502.0	7.10
			5 30 55	Fishing Point	185 30 42	5301.7	5797.8	3.29
Jones' Island	38 18 12.25	76 02 46.70	265 09 47	Fishing Point	85 11 06	3099.6	3389.6	1.93
			322 32 20	Roseneer	142 33 01	2755.0	3013.0	1.71
Gray's Island	38 20 26.69	75 57 26.39	61 58 53	Jones' Island	241 55 34	8814.8	9639.6	5.48
			108 26 47	Snake Island	288 25 00	4407.0	4819.4	2.47

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Insley's Mill	38 18 56.04	76 02 50.68	288 51 51	Fishing Point	108 53 12	3366.3	3681.3	2.09
			355 53 36	Jones' Island	175 53 39	1353.3	1479.9	0.84
Clay Island Light	38 13 53.05	75 58 08.46	245 01 27	Sandy Island	65 02 44	3319.3	3629.9	2.06
			54 46 44	Piny Hammock	234 44 19	6989.0	7643.0	4.34
Ballard	38 14 20.21	75 50 40.72	49 42 59	Frank's Island	229 40 18	8257.4	9030.0	5.13
			94 07 11	Sandy Island	274 03 51	7898.0	8637.0	4.91
Long Point, (Monie Bay)	38 12 10.02	75 53 02.94	136 00 45	Sandy Island	315 58 53	6363.5	6958.9	3.95
			220 44 39	Ballard	40 46 07	5298.7	5794.5	3.30
Stump Point	38 13 38.86	75 53 32.26	252 59 27	Ballard	73 01 13	4361.7	4769.8	2.71
			87 54 50	Bishop's Head	267 49 11	13350.3	14599.5	8.29
Nanticoke River.								
Cow Creek	38 18 36.66	75 55 42.30	208 25 12	Green's Island	28 26 01	4031.4	4408.6	2.50
			311 12 39	Ragged Point	131 13 40	3202.4	3502.1	1.99
Hat Crown Point	38 19 32.81	75 52 45.11	68 06 37	Cow Creek	248 04 47	4638.9	5073.0	2.88
			127 17 08	Green's Island	307 16 07	2996.2	3276.6	1.86
Beach	38 21 02.06	75 52 57.67	353 40 43	Hat Crown Point	173 40 51	2768.5	3027.6	1.72
			65 44 49	Green's Island	245 43 56	2280.4	2493.8	1.42
Cedar Hammock	38 20 41.51	75 51 33.78	39 17 08	Hat Crown Point	219 16 23	2736.3	2992.3	1.70
			107 17 17	Beach	287 16 25	2133.1	2332.7	1.33
Brick Kiln Cove	38 22 20.29	75 51 51.09	352 08 48	Cedar Hammock	172 08 59	3074.2	3361.9	1.91
			33 50 12	Beach	213 49 30	2903.4	3175.1	1.80

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ″ ′	*Metres.*	*Yards.*	*Miles.*
Oak Hammock	38 21 36.43	75 50 31.07	41 57 55	Cedar Hammock	221 57 16	2277.1	2490.2	1.42
			124 51 12	Brick Kiln Cove	304 50 22	2366.5	2587.9	1.47
Donoho	38 23 19.97	75 51 17.98	340 22 15	Oak Hammock	160 22 44	3389.1	3706.2	2.11
			23 35 39	Brick Kiln Cove	203 35 18	2007.9	2195.8	1.25
Sankey's Island	38 23 34.30	75 49 33.95	20 53 32	Oak Hammock	200 52 56	3889.4	4252.3	2.36
			80 05 13	Donoho	260 04 09	2562.7	2802.5	1.59
Windmill Hill	38 24 11.49	75 50 52.32	301 05 27	Sankey's Island	121 06 16	2220.5	2428.3	1.38
			21 24 42	Donoho	201 24 26	1706.2	1865.9	1.06
Red Oak Island	38 24 41.17	75 48 55.63	24 16 34	Sankey's Island	204 16 10	2261.8	2473.4	1.40
			72 05 55	Windmill Hill	252 04 43	2975.0	3253.4	1.85
Nanticoke Manor	38 25 36.25	75 50 12.00	312 30 39	Red Oak Island	132 31 27	2513.0	2748.2	1.56
			20 31 33	Windmill Hill	200 31 08	2790.3	3051.4	1.73
Den Creek	38 25 44.80	75 48 44.77	7 39 06	Red Oak Island	187 38 59	1979.3	2164.5	1.23
			82 54 34	Nanticoke Manor	262 53 40	2131.8	2331.3	1.32
Vickers	38 26 27.33	75 49 49.54	309 51 14	Den Creek	129 51 54	2046.8	2237.4	1.27
			19 04 59	Nanticoke Manor	199 04 45	1666.3	1822.2	1.04
Gum Island	38 27 09.22	75 48 40.57	2 14 54	Den Creek	182 14 51	2604.6	2848.3	1.62
			52 20 03	Vickers	232 19 20	2113.0	2310.7	1.31
Point Pleasant	38 27 35.70	75 49 36.05	301 15 22	Gnm Island	121 15 56	1573.5	1720.7	0.98
			8 49 30	Vickers	188 49 21	2133.1	2332.7	1.33
Barren Creek	38 27 52.50	75 47 54.45	39 57 47	Gum Island	219 57 18	1740.7	1903.6	1.08
			78 08 14	Point Pleasant	258 07 11	2516.7	2752.2	1.56

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Vienna	38 29 07.57	75 48 56.18	327 07 14	Barren Creek	147 07 52	2756.0	3013.9	1.71
			18 50 41	Point Pleasant	198 50 16	2992.8	3272.8	1.86
Tangier Sound.								
Solomon Evans	38 02 27.21	76 00 42.61	139 11 36	Holland	319 08 48	10148.8	11098.4	6.31
			217 00 34	Thomas	37 03 09	10077.1	11020.0	6.26
Jane's Island	37 58 30.03	75 53 37.33	125 12 58	Solomon Evans	305 08 36	12691.2	13878.7	7.89
			164 23 05	Thomas	344 21 16	15946.2	17438.3	9.91
Prickly Point	38 05 13.10	75 52 07.75	97 41 11	Holland	277 33 05	19347.2	21157.5	12.02
			9 58 43	Jane's Island	189 57 44	12617.1	13797.7	7.84
Shank's Hammock	37 55 15.59	76 02 09.48	.....	.....	.....	.....	.....	.....
Long Island	38 08 10.37	76 05 47.29	189 05 17	Bloodsworth	9 05 35	4447.5	4863.7	2.76
			344 46 37	Holland	164 46 57	3005.9	3287.2	1.87
Jones	38 01 21.20	76 02 42.58	159 05 58	Holland	339 04 24	10399.3	11372.4	6.46
			118 52 11	Point No Point	298 42 06	27290.0	29843.5	16.96
Barn Point	37 59 50.29	75 58 47.61	149 54 41	Solomon Evans	329 53 30	5591.8	6115.0	3.48
			288 04 21	Jane's Island	108 07 32	13931.4	15235.0	8.66
Horse Hammock	37 57 08.94	75 59 18.65	215 06 37	Prickly Point	35 11 02	18250.0	19957.7	11.34
			253 16 01	Jane's Island	73 19 31	8697.5	9511.3	5.41
Fog Point Light	38 02 03.67	75 02 14.84	223 27 00	Thomas	43 30 31	12086.9	13217.9	7.51
			252 05 56	Solomon Evans	72 06 52	2363.1	2584.2	1.47

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Little Bolton	38 01 47.25	75 49 39.74	43 38 51	Jane's Island	223 36 25	8400.5	9186.5	5.22
			150 23 34	Prickly Point	330 22 03	7300.0	7983.1	4.54
Crane Point	38 03 33.42	75 48 34.18	38 20 58	Jane's Island	218 17 51	11923.2	13038.9	7.41
			120 34 27	Prickly Point	300 32 15	6044.3	6609.9	3.76
Piny Island	38 06 28.09	75 54 58.09	48 32 14	Solomon Evans	228 28 42	11209.0	12275.8	6.96
			299 06 32	Prickly Point	119 08 18	4750.3	5194.8	2.95
St. Pierre	38 07 18.52	75 49 59.99	116 09 27	Turkey Point	296 05 19	10888.2	11907.0	6.77
			38 50 32	Prickly Point	218 49 13	4963.8	5428.3	3.08
Bluff, (Tree)	38 05 20.38	76 00 50.38	270 57 48	Prickly Point	91 03 11	12736.3	13928.0	7.91
			109 58 57	Holland	289 56 14	6855.2	7496.7	4.26
Spring Island	38 07 54.13	76 03 36.83	44 52 06	Holland	224 51 06	3385.7	3702.5	2.10
			337 08 43	Solomon Evans	157 10 30	10936.3	11959.6	6.80
Cedar Hammock Point	38 06 28.27	76 02 44.06	338 16 16	Solomon Evans	158 17 31	7999.3	8747.8	4.97
			154 07 12	Spring Island	334 06 39	2942.5	3217.8	1.83
South Marshes	38 05 04.52	76 03 07.79	132 25 58	Holland	312 24 40	4194.3	4586.8	2.61
			172 18 04	Spring Island	352 17 46	5276.9	5770.7	3.28
Cold Quarter	38 09 07.38	76 01 24.75	50 17 15	Holland	230 14 53	7287.2	7969.1	2.53
			355 14 23	Solomon Evans	175 14 49	12379.5	13537.9	7.69
Pea Hill	38 07 39.67	76 21 25.11	309 02 43	Shank's Hammock	129 14 35	36337.8	39737.9	22.58
			274 38 37	Holland	94 48 36	23711.2	25929.9	14.73
Fox Island	37 53 52.70	75 54 14.52	102 27 45	Shank's Hammock	282 22 53	11879.0	12990.5	7.38
			31 54 45	Tangier	211 51 52	13030.2	14249.4	8.10

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Goose Harbor	37 52 01.51	75 59 53.21	159 55 14	Shank's Hammock	330 53 51	6846.8	7487.5	4.25
			247 28 20	Fox Island	67 31 48	8957.5	9795.7	5.57
Tangier Island	37 47 53.81	75 58 56.11	....	....	....	....	....	....
Pocomoke Bay.								
Beach Island	37 47 31.19	75 49 07.57	92 49 26	Tangier	272 43 25	14413.3	15762.0	8.95
			147 29 17	Fox Island	327 26 09	13950.4	15255.7	8.67
Woody Island	37 42 09.75	75 52 16.55	137 21 23	Tangier	317 17 18	14428.0	15778.0	8.96
			20 36 01	Sandy Point	200 33 34	16834.9	18410.1	10.46
Scott's Hall	37 44 27.41	75 49 22.37	114 25 46	Tangier	294 19 55	15414.0	16856.3	9.58
			183 39 26	Beach Island	3 39 35	5677.1	6208.3	3.53
Watt's Island	37 48 51.98	75 53 15.92	77 52 00	Tangier	257 48 31	8511.5	9307.9	5.29
			171 13 20	Fox Island	351 12 45	9380.5	10258.2	5.83
Watt's Island Light	37 46 52.62	75 53 17.80	102 52 09	Tangier	282 48 42	8488.6	9282.9	6.28
			258 59 16	Beach Island	79 01 50	6235.9	6819.4	3.88
Sykes Island	37 55 09.44	75 43 30.31	30 17 43	Beach Island	210 14 16	16356.5	17887.0	10.16
			81 30 10	Fox Island	261 23 35	15911.7	17400.6	9.89
Watermelon Hammock	37 56 32.46	75 50 08.58	125 26 42	Jane's Island	305 24 25	6252.9	6838.0	3.89
			284 42 25	Sykes Island	104 46 37	10055.8	10996.7	6.25
Tunnel's Island	37 53 53.88	75 45 21.86	25 05 11	Beach Island	205 02 52	13024.6	14243.3	8.09
			229 27 39	Sykes Island	49 28 48	3585.3	3920.8	2.23

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Maremscot	37 58 21.93	75 42 080.1	18 42 48	Sykes Island	198 41 58	6265.1	6851.3	3.89
			29 49 07	Tunnel's Island	209 47 08	9523.5	10414.7	5.93
Guildford Island	37 50 36.16	75 42 14.99	167 40 57	Sykes Island	347 40 10	8623.3	9430.2	5.36
			143 10 33	Tunnel's Island	323 08 38	7616.4	8329.1	4.73
Deep Creek Island	37 47 31.61	75 45 08.07	89 53 37	Beach Island	269 51 10	5859.3	6407.6	3.64
			216 58 10	Guildford Island	36 39 56	7091.5	7755.1	4.41
Watkins' Point	37 56 51.18	75 48 02.83	295 12 43	Sykes Island	115 15 31	7356.3	8044.6	4.57
			324 15 59	Tunnel's Island	144 17 38	6732.6	7362.6	4.18
Kellum	37 40 03.28	75 51 35.85	143 25 18	Tangier	323 20 49	18071.8	19762.8	11.23
			194 43 07	Beach Island	14 44 38	14277.2	15613.1	8.87
Chesapeake Bay, Western Shore.								
Abell	38 16 52.88	76 23 09.17	189 18 32	Tom's Point	97 26 07	18005.5	19690.3	11.19
			228 02 32	Cedar Point	48 03 25	2823.1	3087.3	1.75
Tarleton	38 14 07.48	76 23 11.96	261 05 45	Tom's Point	81 13 22	18146.3	19844.3	6.80
			197 14 18	Cedar Point	17 15 13	7315.3	7999.8	4.54
Point No Point	38 08 27.45	76 19 04.11	....	....	....	....	....	....
Point Look-out	38 02 44.74	76 19 04.86	180 06 13	Point No Point	0 06 13	10565.4	11554.0	6.56
			250 29 24	Holland	70 37 55	21449.4	23456.4	13.33
Point Look-out Light	38 02 15.75	76 19 01.49	174 42 43	Point Look-out	354 42 41	897.9	981.9	0.55
			248 11 26	Holland	68 19 56	21678.2	23716.5	13.48

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Taylor	38 03 25.02	76 19 05.39	180 11 34	Point No Point	0 11 35	9323.9	10196.3	5.79
			253 41 00	Holland	73 49 32	21078.9	23051.2	13.10
Point Look-in	38 05 52.39	76 19 30.79	187 44 25	Point No Point	7 44 42	4824.4	5275.9	3.00
			266 12 46	Holland	86 21 34	20894.2	22849.3	12.98
SMITH'S POINT LIGHT	37 53 14.59	76 13 58.30	....	....	....	....	....	....
Hack's Neck	37 54 37.30	76 15 38.92	168 57 21	Point No Point	348 55 15	26077.7	28517.8	16.20
			214 25 28	Holland	34 31 53	26889.1	29405.1	16.71
Hull's Neck	37 56 57.16	76 20 48.81	193 18 09	Point Look-out	13 19 13	11011.8	12042.2	6.84
			276 26 27	Shank's Hammock	96 37 55	27509.1	30083.1	17.09
Fleet's Point	37 48 44.35	76 16 40.51	358 22 05	Windmill Point	178 22 21	22282.9	24367.9	13.85
			273 20 03	Tangier Island	93 30 56	26081.1	28521.5	16.21
Spry's Hill	37 52 14.20	76 18 40.59	256 54 39	Shank's Hammock	77 04 48	24849.7	27174.9	15.44
			254 52 19	Smith's Point Light	74 55 12	7145.3	7813.9	4.44
Taskmaker	37 50 00.78	76 14 37.90	189 12 12	Smith's Point Light	9 12 37	6052.7	6619.1	3.76
			241 58 59	Shank's Hammock	62 06 39	20703.7	22640.9	12.86
Doctor Hudnell	37 47 37.15	76 20 26.74	196 53 42	Spry's Hill	16 54 47	8926.6	9761.9	5.55
			268 57 28	Tangier Island	89 10 39	31576.3	34530.9	19.62
Damerone's Marsh	37 46 55.59	76 17 32.30	170 21 21	Spry's Hill	350 20 39	9962.9	10895.1	6.19
			200 42 08	Fleet's Point	20 42 40	3584.3	3919.7	2.23
Bluff Point	37 41 16.45	76 17 43.54	18	Fleet's Point	6 22 56	13893.9	15194.0	8.63
			15	Tangier Island	66 09 45	30196.0	33021.4	18.76

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Nantepoison	37 38 25.59	76 17 32.63	183 49 27	Fleet's Point	3 49 59	19117.7	20906.6	11.88
			237 15 30	Tangier Island	57 26 53	32471.4	35509.7	20.18
Hughlett's Neck	37 43 41.50	76 17 59.04	191 37 34	Fleet's Point	11 38 22	9532.2	10424.1	5.92
			254 21 45	Tangier Island	74 33 25	29032.9	31749.5	18.04
WINDMILL POINT	37 36 41.82	76 16 14.63	186 12 41.9	Smith's Point Light-house	6 14 05.4	30786.3	33667.0	19.13
			230 45 04.6	Tangier Island	50 55 39.8	32804.5	35874.0	20.37
Stingray	37 33 35.14	76 17 21.72	195 57 12	Windmill Point	15 57 53	5985.6	6545.7	3.72
			269 42 09	Sandy Point	89 54 59	31013.9	33915.9	19.27
Cherry Point	37 31 00.36	76 17 26.91	189 33 28	Windmill Point	9 34 12	10674.6	11673.4	6.63
			260 59 56	Sandy Point	81 12 50	31529.0	34479.1	19.59
Gwynn's Island	37 28 21.76	76 15 14.82	174 33 52	Windmill Point	354 33 15	15485.1	16934.1	9.62
			250 37 36	Sandy Point	70 49 09	29573.7	32340.8	18.38
WOLF TRAP	37 24 00.73	76 14 24.22	173 25 22	Windmill Point	353 24 15	23617.6	25827.5	14.67
			236 11 32	Sandy Point	56 22 33	32085.4	35375.0	20.38
New Pt. Comfort Light-house	37 17 59.06	76 16 22.01	....	....	....	....	....	....
Cape Henry Light-house	36 55 28.63	76 00 11.55	....	....	....	....	....	....
Old Pt. Comfort Light-house	37 00 02.10	76 18 05.68	....	....	....	....	....	....
Smith's Island Light-house	37 07 47.67	75 52 12.06	....	....	....	....	....	....
SANDY POINT	37 33 38.48	75 56 17.92	....	....	....	....	....	....

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Nandua	37 36 44.38	75 54 36.93	89 58 04	Windmill Point	269 44 52	31823.8	34801.6	19.77
			198 55 17	Woody Island	18 56 43	10604.0	11596.2	6.59
Heath	37 31 12.21	75 56 49.79	109 40 06	Windmill Point	289 28 16	30335.4	33173.9	18.85
			189 50 30	Sandy Point	9 50 49	4576.5	5004.7	2.84
Bay View	37 28 36.87	75 57 37.14	118 41 10	Windmill Point	298 29 49	31238.6	34161.6	19.41
			191 48 35	Sandy Point	11 49 23	9499.1	10387.9	5.90
Naswaddox	37 26 36.07	75 58 17.76	78 41 19	Wolf Trap	258 31 32	24240.9	26509.1	15.06
			192 43 34	Sandy Point	12 44 47	13350.1	14599.3	8.29
ROSEMARY	37 19 54.83	76 00 29.21	....	....	....	....	....	....
COAST SOUTH OF CAPE HENLOPEN.								
Cape Henlopen	38 46 45.11	75 04 45.55	....	....	....	....	....	....
Lewes Entrance	38 48 48.24	75 11 32.41	....	....	....	....	....	....
Burton's Tripod	38 42 36.69	75 09 18.64	220 48 06	Cape Henlopen	40 50 58	10122.8	11070.0	6.29
			164 15 58	Lewes Entrance	344 14 34	11904.0	13017.9	7.40
Rehoboth Beach	38 41 11.92	75 04 03.73	174 31 15	Cape Henlopen	354 30 49	10320.7	11286.4	6.41
			108 59 04	Burton's Tripod	388 55 47	8040.0	8792.3	5.00
Angola	38 38 54.73	75 07 13.34	227 16 44	Rehoboth Beach	47 18 43	6236.9	6820.5	3.88
			156 08 30	Burton's Tripod	336 07 12	7483.5	8183.7	4.65
Long Neck	38 37 26.65	75 05 53.24	144 30 31	Angola	324 29 41	2335.7	2554.3	1.45
			200 51 23	Rehoboth Beach	20 52 31	7433.2	8128.7	4.62

United States Coast Survey.—Geographical Positions. Section III.—Coast South of Cape Henlopen. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Rehoboth Marsh	38 38 49.43	75 03 53.62	91 57 22	Angola	271 55 17	4831.8	5283.9	3.00
			176 48 59	Rehoboth Beach	356 48 53	4400.2	4811.9	2.73
Indian River Inlet	38 36 19.55	75 03 18.74	173 07 19	Rehoboth Beach	353 06 51	9079.9	9929.5	5.64
			130 09 30	Angola	310 07 04	7442.1	8116.6	4.61
Salt Works	38 35 35.20	75 03 14.49	131 50 11	Long Neck	311 48 32	5135.5	5616.0	3.19
			175 42 13	Indian River Inlet	355 42 10	1371.3	1599.6	0.85
Mouth of White Creek	38 35 19.12	75 06 10.49	263 20 45	Salt Works	83 22 35	4287.4	4688.6	2.66
			186 03 16	Long Neck	6 03 26	3954.2	4324.2	2.46
Burton's Island	38 36 43.56	75 04 55.53	310 45 52	Salt Works	130 46 55	3227.8	3529.8	2.01
			34 51 56	Mouth of White Creek	214 51 10	3173.0	3469.9	1.97
Laws	38 34 27.76	75 04 27.72	220 26 08	Salt Works	40 26 54	2731.9	2987.5	1.70
			159 26 38	Long Neck	339 25 45	5891.1	6442.3	3.66
Allen	38 34 30.28	75 03 08.53	175 52 37	Salt Works	355 52 33	2006.5	2194.3	1.25
			87 40 54	Laws	267 40 05	1918.2	2097.7	1.19
Holland's Hammock	38 33 27.57	75 04 13.94	219 18 38	Allen	39 19 19	2499.0	2732.8	1.55
			169 48 43	Laws	349 48 35	1885.3	2061.7	1.17
Salt Pond Beach	38 33 21.39	75 03 04.97	135 37 03	Laws	315 36 12	2863.5	3131.4	1.78
			96 31 13	Holland's Hammock	276 30 30	1680.6	1837.9	1.04
Hall's Beach	38 32 25.62	75 02 56.16	172 55 36	Salt Pond Beach	352 55 30	1732.5	1894.6	1.08
			135 24 24	Holland's Hammock	315 23 40	2682.5	2933.5	1.67
Evans	38 32 20.76	75 04 00.31	264 28 34	Hall's Beach	84 29 14	1560.6	1706.6	0.97
			215 37 48	Salt Pond Beach	35 38 23	2300.0	2515.2	1.43

United States Coast Survey.—Geographical Positions. Section III.—Coast South of Cape Henlopen. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Holland	38 33 23.95	75 04 52.37	168 52 06	Long Neck	348 51 28	7626.7	8340.2	4.74
			210 20 12	Salt Works	30 21 13	4688.9	5127.6	2.91
Hall's Fishery	38 31 50.21	75 02 52.15	175 32 34	Salt Works	355 32 20	6957.8	7608.8	4.32
			134 48 19	Holland	314 47 04	4102.1	4485.9	2.55
Tunnel	38 30 43.62	75 04 31.23	174 05 24	Holland	354 05 11	4969.7	5434.7	3.09
			229 26 48	Hall's Fishery	49 27 49	3158.3	3453.8	1.96
Daisy Marsh	38 29 02.84	75 02 46.55	140 47 03	Tunnel	320 45 58	4010.9	4386.2	2.49
			178 29 43	Hall's Fishery	358 29 40	5161.9	5644.9	3.21
Rodger	38 28 06.83	75 04 31.40	180 02 53	Tunnel	0 02 53	4834.0	5286.3	3.00
			235 47 33	Daisy Marsh	55 48 38	3072.4	3359.9	1.91
Fenwick	38 26 42.55	75 02 41.70	134 20 54	Rodger	314 19 46	3718.2	4066.1	2.31
			178 26 37	Daisy Marsh	358 26 34	4327.1	4732.0	2.69
Riley	38 25 22.04	75 06 07.91	243 28 26	Fenwick	63 30 34	5561.2	6081.6	3.46
			204 29 46	Rodger	24 30 46	5583.7	6106.2	3.47
Brig Knots	38 24 13.27	75 03 21.14	191 44 19	Fenwick	11 44 43	4700.8	5140.7	2.92
			117 48 59	Riley	297 47 16	4545.9	4971.3	2.83
Wight	38 23 27.67	75 05 41.65	170 08 28	Riley	350 08 12	3578.9	3913.8	2.23
			247 31 44	Brig Knots	67 36 11	3687.5	4032.5	2.29
Beach House	38 20 58.98	75 04 08.16	153 40 33	Wight	333 39 35	5115.7	5594.4	3.18
			190 46 48	Brig Knots	10 47 18	6098.0	6668.6	3.79
Davis	38 20 25.08	75 06 02.14	185 02 56	Wight	5 03 09	5651.6	6180.4	3.51
			249 18 39	Beach House	69 19 50	2958.2	3235.0	1.84

United States Coast Survey.—Geographical Positions. Section III.—Coast South of Cape Henlopen. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles*
Dromedary	38 18 59.37	75 05 08.01	201 30 45	Beach House	21 31 22	3963.4	4334.3	2.46
			153 33 32	Davis	333 32 58	2951.4	3227.6	1.83
Quilling	38 18 10.42	75 06 43.56	193 37 01	Davis	13 37 27	4271.9	4671.6	2.65
			236 57 22	Dromedary	56 58 21	2768.5	3027.6	1.72
Flat Mound	38 17 09.07	75 06 05.77	292 25 01	Dromedary	22 25 37	3678.9	4023.1	2.29
			154 06 50	Quilling	334 06 26	2102.6	2299.4	1.31
Ship Yard	38 16 27.85	75 07 53.05	208 05 42	Quilling	28 06 25	3584.8	3920.2	2.23
			244 00 21	Flat Mound	64 01 27	2900.2	3171.6	1.80
Twin Hills	38 14 54.66	75 07 23.63	204 32 28	Flat Mound	24 33 16	4555.5	4981.8	2.83
			166 01 38	Ship Yard	346 01 20	2960.7	3237.7	1.84
Powell	38 14 22.22	75 09 31.67	252 10 38	Twin Hills	72 11 57	3269.9	3575.9	2.03
			211 44 55	Ship Yard	31 45 57	4555.3	4981.6	2.83
North Birch	38 12 17.35	75 08 47.98	164 34 32	Powell	344 34 05	3993.8	4367.5	2.48
			202 55 12	Twin Hills	22 56 05	5266.1	5758.8	3.27
South Point Island	38 12 14.59	75 11 20.24	268 40 25	North Birch	88 41 59	3705.2	4051.9	2.30
			213 51 28	Powell	33 52 36	4738.8	5182.2	2.95
South Birch	38 09 15.33	75 10 08.51	162 56 10	South Point Island	342 55 27	5781.3	6322.3	3.59
			199 41 09	North Birch	19 42 00	5960.1	6517.8	3.70
Robins' Marsh	38 09 11.98	75 14 33.14	269 19 44	South Birch	89 22 26	6394.1	6992.4	3.97
			219 57 42	South Point Island	39 59 41	7306.6	7990.3	4.54
Green Run	38 04 53.41	75 11 51.42	153 48 28	Robins' Marsh	333 46 48	8919.3	9753.9	5.54
			196 55 19	South Birch	16 56 21	8440.7	9239.5	5.25

United States Coast Survey.—Geographical Positions. Section III.—Coast South of Cape Henlopen. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Big Bay Point	38 04 56.52	75 16 58.20	270 42 26	Green Run	90 45 36	7476.4	8176.0	4.65
			204 03 57	Robins' Marsh	24 05 26	8660.3	9470.7	5.38
Pope's Island Beach	38 01 24.28	75 14 23.73	209 55 36	Green Run	29 57 10	7549.5	8255.9	4.69
			150 05 38	Big Bay Point	330 04 03	7440.2	8136.4	4.62
Hardy's Hole Island	38 01 52.73	75 18 56.51	277 29 27	Pope's Island Beach	97 32 15	6709.7	7337.5	4.17
			206 57 55	Big Bay Point	26 59 08	6357.6	6952.5	3.95
Lonesome Hill	37 58 45.79	75 16 48.12	151 29 32	Hardy's Hole Island	331 28 13	6559.3	7173.1	4.08
			215 46 38	Pope's Island Beach	35 48 07	6023.3	6586.9	3.74
Snead	37 58 18.18	75 25 51.43	266 16 57	Lonesome Hill	86 22 31	13286.0	14529.2	8.26
			236 48 11	Hardy's Hole Island	56 52 26	12091.5	13222.9	7.51
Assateague light-house (vane)	37 54 37.22	75 21 03.64	134 08 22	Snead	314 05 25	9786.2	10701.9	6.08
			219 07 43	Lonesome Hill	39 10 20	9881.2	10805.8	6.14
Assateague light-house (signal.)	37 54 37.27	75 21 03.69	134 08 14	Snead	314 05 17	9784.6	10700.2	6.08
			219 08 17	Lonesome Hill	39 10 54	9880.8	10805.4	6.14
Wallop's Island	37 52 25.04	75 25 51.12	239 50 38	Assateague Light, (signal)	59 53 34	8119.6	8879.4	5.05
			179 57 42	Snead	359 57 41	10886.7	11905.4	6.76
Taylor	37 52 32.34	75 29 28.11	272 24 47	Wallop's Island	92 27 00	5307.1	5803.7	3.20
			206 22 35	Snead	26 24 48	11902.7	13016.5	7.39
Sheep-pen Flat	37 57 31.03	75 17 36.11	96 53 59	Snead	276 48 54	12176.4	13315.8	7.57
			43 26 04	Assateague Light, (signal)	223 23 56	7374.7	8064.8	4.58
Assawoman Inlet	37 49 58.95	75 28 49.54	168 43 50	Taylor	348 43 26	4821.8	5273.0	3.00
			224 03 57	Wallop's Island	44 05 46	6270.1	6856.8	3.90

United States Coast Survey.—Geographical Positions. Section III.—Coast South of Cape Henlopen. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Nack	37 49 28.21	75 31 42.59	210 04 07	Taylor	30 05 29	6559.6	7173.4	4.08
			257 21 54	Assawoman Inlet	77 23 40	4336.2	4741.9	2.69
Mèran	37 47 45.05	75 30 29.70	150 43 55	Nack	330 43 10	3645.8	3986.9	2.27
			210 40 49	Assawoman	30 41 50	4799.8	5248.9	2.98
Britnam	37 46 55.07	75 32 48.73	198 54 45	Nack	18 55 25	4990.6	5457.6	3.10
			245 37 06	Mèran	65 38 31	3734.1	4083.5	2.32
South Gargathy	37 45 20.21	75 31 50.46	203 52 09	Mèran	23 52 59	4883.1	5340.0	3.03
			154 00 44	Britnam	334 00 08	3253.4	3557.8	2.02
Watson	37 44 15.85	75 34 47.80	245 25 24	South Gargathy	65 27 12	4773.1	5219.7	2.97
			210 41 22	Britnam	30 42 35	5708.4	6242.2	3.55
Matomkan	37 41 43.32	75 33 53.42	164 11 32	Watson	344 10 59	4887.0	5344.3	3.04
			204 13 57	South Gargathy	24 15 12	7332.8	8018.9	4.56
Joynes	37 41 47.88	75 36 28.70	208 26 08	Watson	28 27 09	5187.8	5673.2	3.22
			272 06 11	Matomkan	92 07 46	5806.2	4162.4	2.37
Cedar Island	37 39 24.40	75 34 46.62	150 31 23	Joynes	330 30 21	5081.2	5556.7	3.16
			196 55 33	Matomkan	16 56 05	4476.6	4895.5	2.78
Custis	37 39 15.31	75 38 14.48	208 51 00	Joynes	28 52 05	5370.1	5872.6	3.34
			266 50 01	Cedar Island	86 52 08	5102.3	5579.7	3.17
Horse-shoe	37 37 03.60	75 35 36.71	136 24 17	Custis	316 22 40	5607.7	6132.4	3.49
			195 47 36	Cedar Island	15 48 07	4511.1	4933.2	2.80
Haulover	37 37 03.07	75 40 00.13	212 25 18	Custis	32 26 23	4829.6	5281.5	3.00
			269 50 06	Horse-shoe	89 52 47	6459.5	7063.9	4.01

United States Coast Survey.—Geographical Positions. Section IV.—Primary Stations. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Bodie's Isl'd Base { N. end.	35 53 56.56	E. 0 35 32.90						
Bodie's Isl'd Base { S. end.	35 48 34.03	0 38 25.45	156 28 48.0	North Base	336 27 06.9	10841.5	11855.9	6.735
Roanoke Marshes	35 48 44.59	0 29 19.82	224 12 03.8	North Base	44 15 42.3	13418.0	14673.5	8.33
			271 19 00.1	South Base	91 24 19.4	13700.3	14982.2	8.51
Bodie's Island, Astronomical Station.	35 47 31.30	0 39 27.53	98 28 13.0	Roanoke Marshes	278 22 17.5	15422.6	16865.7	9.58
			153 38 42.2	North Base	333 36 24.8	13252.3	14492.3	8.23
Mann's Point	35 58 14.44	0 31 23.83	321 49 50.3	North Base	141 52 16.5	10106.1	11051.7	6.27
			10 03 03.9	Roanoke Marshes	190 01 51.2	17835.0	19503.8	11.08
Robert's Fishery	35 56 06.08	24 26.03	331 32 10.9	Roanoke Marshes	151 35 03.1	15473.2	16921.0	9.61
			249 15 54.8	Mann's Point	69 20 00.1	11191.2	12238.3	6.95
Roden	36 00 10.93	0 27 35.91	302 08 48.8	Mann's Point	122 11 02.7	6743.4	7374.4	4.18
			32 14 33.1	Robert's Fishery	212 12 41.6	8920.1	9754.7	5.54
Shellbank	36 03 20.93	0 26 57.96	15 51 40.5	Robert's Fishery	195 50 11.2	13931.3	15234.8	8.65
			324 48 13.4	Mann's Point	144 50 49.7	11555.8	12637.0	7.17
			350 46 41.9	Roden	170 47 03.9	5932.3	6487.4	3.69
Caroon's Point	35 57 23.77	0 23 02.18	233 03 34.2	Roden	53 06 15.0	8576.2	9378.6	5.32
			318 43 29.0	Robert's Fishery	138 44 18.2	3185.7	3483.7	1.97
			208 11 17.9	Shellbank	28 13 36.3	12490.6	13659.4	7.76
			262 52 37.2	Mann's Point	82 57 30.7	12664.8	13849.8	7.87
Powell's Point	36 04 18.83	E. 0 23 26.73	329 45 09.0	Roden	140 47 35.1	98628.0	10785.6	6.12
			2 45 10.2	Caroon's Point	182 44 55.7	12806.2	14004.4	7.95
			354 24 31.5	Robert's Fishery	174 25 09.4	15258.7	16686.5	9.48
			288 38 22.1	Shellbank	108 40 26.4	5578.5	6100.5	3.47

United States Coast Survey.—Geographical Positions. Section IV.—Primary Stations. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Tillet	36 06 04.40	E. 0 20 29.36	346 31 33.9	Carroon's Point	166 36 03.8	16494.7	18038.1	10.24
			315 32 43.2	Roden	135 36 54.2	15252.0	16679.1	9.47
East Durant Island	35 58 34.51	0 17 35.74	258 46 06.2	Roden	78 51 58.8	15323.4	16757.2	9.51
			197 23 16.8	Tillet	17 24 58.9	14530.2	15889.8	9.02
			219 35 47.5	Powell's Point	39 39 15.0	13777.6	15066.8	8.56
Pear-tree Point	35 59 05.60	0 08 30.44	273 58 07.2	East Durant Island	94 03 27.5	13692.6	14973.8	8.50
			234 17 21.9	Tillet	54 24 24.9	22144.0	24216.0	13.75
Wade's Bluff	36 08 13.32	E. 0 06 54.63	351 54 29.8	Pear-tree Point	171 55 26.2	17049.6	21220.8	12.05
			280 58 10.8	Tillet	101 06 11.1	20756.0	14739.1	8.37
Reed's Point	36 05 42.58	W. 0 01 31.33	309 02 09.7	Pear-tree Point	129 08 03.8	19405.1	18644.9	10.59
			249 47 44.3	Wade's Bluff	69 52 42.5	13478.0	22698.1	12.89
Palmetto	35 59 42.31	E. 0 02 33.47	202 39 48.8	Wade's Bluff	22 33 22.6	17050.9	18646.3	10.59
			151 07 45.6	Reed's Point	331 05 21.5	12681.5	13868.1	7.89
Stevenson's Point	36 06 18.21	E. 0 00 00.00	342 30 51.9	Palmet o	162 32 22.2	12791.6	13988.5	7.94
			251 04 32.9	Wade's Bluff	71 08 37.4	10957.6	11982.9	6.80
Brick House	35 59 12.20	W. 0 01 08.05	177 13 44.7	Reed's Point	357 13 31.0	12045.1	13172.1	7.48
			215 52 28.4	Wade's Bluff	35 57 12.5	20591.1	22518.2	12.79
Batt's Grove	36 04 04.23	W. 0 11 47.41	299 17 49.3	Brick House	119 24 05.3	18362.5	20080.6	11.40
			258 49 26.0	Reed's Point	78 55 28.8	15707.5	17177.3	9.77
Laurel Point	35 59 03.48	W. 0 12 29.60	269 02 32.6	Brick House	89 09 13.0	17072.9	18670.4	10.61
			186 29 50.1	Batt's Grove	6 30 14.9	9328.8	10201.7	5.79

United States Coast Survey.—Geographical Positions. Section IV.—Primary Stations. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Leary	36 01 22.97	W.0 16 23.29	234 13 54.4	Batt's Grove	54 16 36.7	8507.3	9303.3	5.28
			306 16 58.4	Laurel Point	126 19 15.8	7261.2	7940.6	4.51
Sleepy Hole	35 58 42.49	0 14 07.41	199 27 17.6	Batt's Grove	19 28 39.9	10516.8	11500.8	6.53
			145 28 54.4	Leary	325 27 34.5	6003.3	6565.0	3.73
Sleight	35 57 33.92	0 18 00.47	199 00 53.6	Leary	19 01 50.7	7467.0	8165.6	4.63
			250 04 56.4	Sleepy Hole	70 07 13.3	6209.4	6790.4	3.85
Sandy Point	36 00 22.09	0 19 27.07	247 48 05.6	Leary	67 49 53.7	4969.3	5434.3	3.08
			337 16 55.2	Sleight	157 17 46.1	5618.6	6144.3	3.49
			290 57 03.4	Sleepy Hole	111 00 10.9	8574.2	9376.5	5.33
Mackay's Creek	36 56 27.13	0 24 40.85	258 22 27.6	Sleight	78 26 22.7	10241.7	11200.0	6.36
			227 19 21.7	Sandy Point	47 22 26.0	10687.3	11687.3	6.64
Hornblower's Point	36 00 42.13	0 23 32.85	275 42 41.6	Sandy Point	95 45 06.1	6185.1	6763.9	3.84
			12 14 07.2	Mackay's Creek	192 13 27.3	8041.3	8793.6	5.00
			304 50 24.9	Sleight	124 53 39.5	10145.8	11095.2	6.30
Williams	35 56 11.25	0 26 53.90	211 05 10.2	Hornblower's Point	31 07 08.9	9749.8	10662.0	6.06
			261 38 18.8	Mackay's Creek	81 39 36.9	3370.3	3685.6	2.10
Capeheart	35 59 07.79	0 29 43.66	252 35 02.3	Hornblower's Point	72 38 40.3	9730.7	10641.2	6.04
			321 58 11.1	Williams	141 59 50.8	6905.9	7552.1	4.29
			303 06 15.1	Mackay's Creek	123 09 13.9	9059.3	9907.0	5.63
Black Walnut Point	36 00 12.01	W.0 29 42.43	264 14 31.1	Hornblower's Point	84 18 08.4	9300.8	10171.1	5.77
			330 20 46.6	Williams	150 22 25.6	8537.1	9335.9	5.30
			312 30 25.0	Mackay's Creek	132 33 22.1	10252.4	11211.7	6.37

United States Coast Survey.—Geographical Positions. Section IV.—Albemarle Sound. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
East Chowan	36 02 08.01	W. 0 27 54.54	291 58 86.9	Hornblower's Point	112 01 10.8	7065.8	7727.0	4.44
			352 07 49.6	W lliams	172 08 25.2	11099.3	12137.8	6.89
			37 04 59.8	Black Walnut Point	217 03 56.5	4480.6	4899.9	2.78
ALBEMARLE SOUND.								
Haulover	35 58 43.56	E. 0 19 10.89	92 28 36	Pear-tree Point	272 22 29	16056.5	17558.9	9.97
			188 13 08	Tillet	8 13 59	13727.3	15011.8	8.52
North River Point	36 09 47.44	0 16 50.64	32 21 39	Pear-tree Point	212 16 44	23407.1	25597.2	14.54
			356 52 55	East Durant Island	176 53 21	20769.8	22713.3	12.90
West Durant Island	35 57 34.72	0 14 27.92	107 23 46	Pear-tree Point	287 20 16	9382.9	10260.9	5.83
			209 54 49	Tillet	29 58 21	18127.1	19823.3	11.28
Long Shoal	35 57 38.09	0 10 24.53	260 49 16	East Durant Island	80 53 29	10941.8	11965.6	6.79
			224 05 13	Tillet	44 11 08	20174.2	23776.3	13.50
East North River	36 07 42.08	0 19 22.03	93 00 49	Wade's Bluff	272 53 19	18709.3	20459.9	11.62
			45 44 31	Pear-tree Point	225 38 07	22787.7	24917.7	14.15
East Pasquotank	36 09 56.19	0 15 07.48	75 36 28	Wade's Bluff	255 31 38	12720.0	13910.2	7.90
			26 23 13	Pear-tree Point	206 19 19	22376.2	24469.9	13.90
West Pasquotank	36 09 08.01	0 08 03.39	357 54 36	Pear-tree Point	177 54 52	18578.1	20316.5	11.54
			261 59 27	East Pasquotank	82 03 37	10702.3	11703.7	6.64
Davenport	35 59 31.41	0 06 54.80	179 58 50	Wade's Bluff	359 58 50	16985.6	17590.7	9.99
			132 07 20	Reed's Point	312 02 22	17069.4	18666.5	10.60
Flatty Creek	36 07 45.63	E. 0 04 17.79	9 56 56	Palmetto	189 55 55	15123.4	16538.5	9.39
			66 32 44	Reed's Point	246 29 18	9519.1	10409.8	5.91

United States Coast Survey.—Geographical Positions. Section IV.—Albemarle Sound. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Leigh's Mills	35 59 27.55	E. 0 03 21.99	185 11 26	Flatty Creek	5 11 58	15414.9	16857.3	9.57
			147 35 56	Reed's Point	327 33 03	13693.2	14974.5	8.50
Ship Point	35 59 40 62	0 01 13.60	197 07 08	Flatty Creek	17 08 56	15643.2	17106.9	9.71
			159 42 18	Reed's Point	339 40 41	11895.3	13008.4	7.39
East Little River	36 07 23.59	E. 0 01 42.85	57 20 50	Reed's Point	237 18 56	5768.7	6308.5	3.58
			354 57 15	Palmetto	174 54 45	14273.5	15609.1	8.87
Jacock's Point	36 06 58.35	W. 0 01 10.81	304 56 04	Stevenson's Point	124 56 45	2160.0	2362.2	1.34
			12 23 57	Reed's Point	192 23 45	2391.1	2614.8	1.49
Harvey's Neck	36 05 24.44	0 07 16.27	266 15 52	Reed's Point	86 19 15	8645.9	9454.8	5.37
			321 11 30	Brick House	141 15 07	14715.6	16092.6	9.14
Westcott's Mill	35 59 14.02	0 00 27.46	138 09 41	Harvey's Neck	318 05 41	15331.6	16766.1	9.53
			172 23 50	Reed's Point	352 23 13	12082.0	13212.5	7.50
Alexander's Mill	35 58 25.94	0 04 16.18	160 44 55	Harvey's Neck	340 43 09	13663.8	14942.3	8.50
			197 01 52	Reed's Point	17 03 29	14076.0	15393.0	8.74
Barrow	36 04 49.48	0 11 32.24	303 34 49	Brick House	123 40 56	18762.7	20518.3	11.65
			263 44 12	Reed's Point	83 50 06	15121.6	16536.5	9.40
Run Point	35 58 19.81	0 04 56.53	140 30 39	Barrow	320 26 47	15569.1	17025.9	9.67
			200 36 30	Reed's Point	20 38 31	14581.2	15945.6	9.05
Bull Point	35 57 16.12	0 10 54.52	173 59 41	Batt's Grove	353 59 10	12648.2	13831.6	7.85
			257 37 31	Run Point	77 41 01	9181.4	10040.6	5.70
Mill Point	35 56 44.25	W. 0 07 31.94	100 57 51	Bull Point	280 55 52	5171.3	5655.2	3.21
			154 45 48	Batt's Grove	334 43 18	14994.1	16397.1	9.31

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United States Coast Survey.—Geographical Positions. Section IV.—Albemarle Sound Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Nixon	36 06 14.28	W. 0 03 53.02	342 22 38	Brick House	162 24 15	13647.6	14924.6	8.47
			73 12 11	Harvey's Neck	253 10 11	5310.6	5807.5	3.29
Burnham	36 06 03.20	0 03 07.79	79 08 22	Harvey's Neck	259 05 56	6328.9	6921.0	3.93
			346 40 47	Brick House	166 41 58	13016.2	14234.1	8.08
Edenton	36 02 46.95	0 24 50.59	47 23 23	Capeheart	227 20 29	9973.4	10906.9	6.20
			14 13 09	Williams	194 11 55	12580.7	13757.9	7.82
Edenton Court-house	36 03 27.45	0 25 04.62	41 08 15	Capeheart	221 05 32	10623.0	11617.2	6.60
			11 30 48	Williams	191 29 44	13719.6	15002.9	8.52
Bluff Point	36 01 34.13	0 16 09.86	310 04 05	Laurel Point	130 06 15	7209.8	7884.4	4.48
			234 49 27	Batt's Grove	54 52 02	8034.4	8786.1	4.99
Benbury	36 03 21.53	0 14 16.58	40 35 37	Bluff Point	220 34 31	4358.6	4766.4	2.70
			341 22 36	Laurel Point	161 23 39	8391.8	9177.0	4.21
Smith's Mill	35 57 12.25	0 18 34.95	167 26 17	Sandy Point	347 25 46	6000.9	6562.4	3.72
			203 04 56	Leary	23 06 13	8407.1	9193.7	5.22
Lewis Island	35 58 20.46	0 15 19.05	121 10 12	Sandy Point	301 07 47	7259.0	7938.2	4.50
			164 03 22	Leary	344 02 44	5856.6	6404.6	3.63
Sleight's Mill	35 57 34.69	0 17 04.27	145 18 32	Sandy Point	325 17 08	6283.1	6871.0	3.90
			188 17 14	Leary	8 17 38	7116.1	7781.9	4.42
Armistead Fishery	35 56 30.81	W. 0 21 16 05	156 08 43	Hornblower's Point	336 07 22	8470.4	9262.9	5.26
			200 56 42	Sandy Point	20 57 44	7633.1	8347.3	4.74

United States Coast Survey.—Geographical Positions. Section IV.—Pasquotank River. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
PASQUOTANK RIVER.	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Bluff Point (2) 1848	36 11 43.34	E. 0 06 48.84	338 43 24	West Pasquotank	158 44 07	5137.2	5617.9	3.19
			284 48 17	East Pasquotank	104 53 11	12889.6	14095.7	8.00
Miles' Mill	36 12 34.10	0 08 48.43	10 02 46	West Pasquotank	190 02 20	6450.6	7054.2	4.00
			62 22 11	Bluff Point (2) 1848	242 21 01	3372.4	3687.9	2.09
Miller's Point	36 14 13.17	0 06 29.23	353 56 40	Bluff Point (2) 1848	173 56 51	4644.0	5078.5	2.89
			311 16 59	Miles' Mill	131 18 22	4627.2	5060.1	2.87
Bluff Point (1)	36 12 29.30	0 05 50.47	196 49 09	Miller's Point	16 49 32	3344.9	3657.9	2.07
			268 04 34	Miles' Mill	88 06 19	4447.8	4864.0	2.76
Bluff Point (2) 1846	36 11 46.19	0 06 49 11	173 44 49	Miller's Point	353 44 38	4557.5	4983.9	2.83
			243 38 00	Miles' Mill	63 39 10	3326.6	3637.9	2.07
Wade's Point	36 09 21.63	0 07 56.41	159 19 29	Bluff Point (2) 1846	339 18 49	4762.5	5208.1	2.95
			192 21 13	Miles' Mill	12 21 43	6073.2	6641.5	3.77
Pocoson Point (1)	36 11 24.27	0 10 04.43	40 15 07	Wade's Point	220 13 51	4952.2	7666.5	4.35
			97 53 45	Bluff Point (2) 1846	277 51 49	4926.4	9457.2	5.37
Pocoson Point (2)	36 10 32.39	0 12 23.04	71 53 49	Wade's Point	251 51 11	7011.5	5415.5	3.07
			115 16 31	Bluff Point (2) 1846	285 13 13	8648.0	5387.3	3.06
Bank's Point	36 10 29.26	0 07 16.30	210 52 48	Miles' Mill	30 53 41	4483.8	4903.3	2.78
			164 00 43	Bluff Point (2) 1846	344 00 27	2466.4	2697.1	1.53
Harvey's Mill	36 12 56.16	E. 0 04 21.15	290 21 07	Bluff Point (1)	110 21 58	2379.5	2602 1	1.48
			233 24 18	Miller's Point	53 25 34	3983.1	4355 8	2.48

United States Coast Survey.—Geographical Positions. Section IV.—Pasquotank River. Sketch D.

Name of station	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Poole's Point	36 13 53.85	E. 0 03 56.90	312 33 57	Bluff Point (1)...............	132 35 04	3851.8	4212.2	2.39
			261 05 07	Miller's Point................	81 06 37	3850.2	4210.4	2.39
Bell's Mill................	36 15 19.54	0 05 24.57	39 39 15	Poole's Point	219 38 23	3430.3	3751.2	2.13
			321 42 35	Miller's Point................	141 43 14	2605.9	2849.7	1.61
Glover's Point	36 15 10.84	0 03 10.91	334 10 31	Poole's Point................	154 10 58	2636.3	2883.0	1.63
			265 23 37	Bell's Mill..................	85 24 56	3347.3	3660.5	2.07
Dozier's Mill	36 16 48.76	0 04 06.84	24 49 27	Glover's Point	204 48 54	3325.4	3527.2	2.06
			324 47 25	Bell's Mill..................	144 48 11	3365.5	3680.4	2.09
Brick House Point	36 15 49.89	0 01 46.52	299 44 03	Glover's Point	119 44 52	2426.1	2653.1	1.50
			242 35 47	Dozier's Mill	62 37 10	3944.1	4313.1	2.45
Anson's Point..............	36 17 21.86	0 01 38.30	355 51 28	Brick House Point	175 51 33	2842.0	3107.9	1.77
			285 22 25	Dozier's Mill	105 23 53	3844.4	4204.1	2.39
Cobb's Point	36 17 14.26	E. 0 00 00.63	264 29 59	Anson's Point................	84 30 57	2448.4	2677.5	1.52
			314 31 36	Brick House Point	134 32 38	3707.5	4054.4	2.30
Hospital Point.............	36 17 43.90	W. 0 00 22.88	327 17 20	Cobb's Point	147 17 34	1085.9	1187.5	0.67
			282 39 06	Anson's Point................	102 40 18	3099.1	3389.0	1.92
Forbes' Mill...............	36 17 34.92	0 00 56.66	251 48 43	Hospital Point...............	71 49 03	887.1	970.1	0.55
			294 00 15	Cobb's Point	114 00 49	1565.0	1711.4	0.97
Elizabeth City Market Signal	36 17 57.30	0 01 41.70	301 32 13	Forbes' Mill.................	121 32 40	1318.5	1441.9	0.81
			281 51 01	Hospital Point...............	101 51 48	2009.5	2197.5	1.24
*Elizabeth City Court-house.	36 18 00.87	W. 0 01 56.13	....	Market Signal	....	376.4	411.6	0.23

United States Coast Survey.—Geographical Positions. Section IV.—Perquimons River. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
PERQUIMONS RIVER.	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Blount's Point	36 07 14.24	W. 0 09 24.15	316 36 06	Harvey's Neck	136 37 22	4656.5	5092.2	2.89
			282 33 07	Nixon's	102 36 22	8484.7	9278.6	5.27
Canaan Cove	36 08 05.65	0 08 36.34	37 01 54	Blount's Point	217 01 26	1984.9	2170.6	1.23
			338 02 20	Harvey's Neck	158 03 07	5357.1	5858.3	3.32
Grassy Point	36 08 17.02	0 11 00.01	308 54 16	Blount's Point	128 55 12	3080.5	3368.7	1.91
			275 33 34	Canaan Cove	95 34 59	3609.0	3946.6	2.24
Halsey Bay	36 07 51.75	0 11 47.90	287 49 01	Blount's Point	107 50 26	3775.9	4129.2	2.34
			236 57 01	Grassy Point	56 57 30	1428.4	1562.0	0.88
Robbins' Point	36 08 37.15	0 12 41.57	316 11 43	Halsey Bay	136 12 14	1938.5	2119.8	1.20
			283 43 09	Grassy Point	103 44 09	2613.5	2858.0	1.62
Old Neck	36 10 38.24	0 13 35.27	340 12 50	Robbins' Point	160 13 22	3957.2	4327.4	2.45
			318 15 59	Grassy Point	138 17 30	5831.3	6376.9	3.62
Barrow	36 10 30.64	0 15 04.26	263 58 28	Old Neck	83 59 21	2236.1	2445.3	1.38
			314 25 51	Robbins' Point	134 27 15	4995.5	5462.9	3.10
Skinner's Fishery	36 11 03.55	0 14 24.25	302 28 17	Old Neck	122 28 46	1452.9	1558.9	0.90
			44 31 41	Barrow	224 31 18	1423.0	1556.2	0.88
Ferry Point	36 11 33.53	W. 0 15 51.18	328 49 51	Barrow	148 50 19	2265.4	2477.4	1.41
			293 03 15	Skinner's Fishery	113 04 07	2358.5	2579.2	1.47
LITTLE RIVER.								
Preliminary Base—South End	36 05 44.83	W. 0 01 26.18	189 38 00	Jacock's Point	9 38 09	2298.2	2513.2	1.43
			244 28 54	Stevenson's Point	64 29 44	2388.4	2611.9	1.48

United States Coast Survey.—Geographical Positions. Section IV.—Little River. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Preliminary Base—North End	36 06 27.38	W. 0 01 41.97	343 14 55	South end of base	163 15 05	1369.5	1497.6	0.85
			276 19 05	Stevenson's Point	96 20 05	2565.7	2805.8	1.59
Mill Point	36 07 30.92	E. 0 00 07.31	62 48 14	Jacock's Point	242 47 34	2195.9	2401.4	1.36
			4 39 35	Stevenson's Point	184 39 36	2248.3	2458.7	1.40
Greaves' Landing	36 08 11.09	W. 0 00 52.52	11 31 32	Jacock's Point	191 31 21	2287.9	2502.0	1.42
			309 36 27	Mill Point	129 37 02	1941.7	2123.4	1.21
Newby's Landing	36 08 49.33	0 02 49.57	324 09 43	Jacock's Point	144 10 41	4218.6	4613.3	2.62
			291 55 39	Greaves' Landing	111 56 48	3154.6	3449.8	1.96
Banks	36 09 33.25	0 02 19.02	29 25 37	Newby's Landing	209 25 19	1554.3	1699.7	0.97
			340 20 04	Jacock's Point	160 20 44	5069.6	5544.0	3.15
Birdsand	36 09 30.16	0 03 23.32	326 09 57	Newby's Landing	146 10 17	1515.0	1656.8	0.94
			266 35 56	Banks	86 36 34	1609.7	1760.3	1.00
Long Point	36 10 28.37	0 03 29.77	354 51 27	Birdsand	174 51 31	1801.6	1970.2	1.12
			313 51 02	Banks	133 51 44	2452.1	2681.6	1.52
Deep Creek Point	36 10 44.48	0 04 46.62	317 43 35	Birdsand	137 44 24	3095.2	3384.8	1.92
			284 28 58	Long Point	104 29 43	1983.2	2168.8	1.23
Trueblood's Point	36 11 14.27	0 04 36.83	14 54 36	Deep Creek Point	194 54 31	950.3	1039.2	0.59
			310 09 58	Long Point	130 10 36	2192.7	2397.9	1.36
Nixonton	36 11 37.46	W. 0 05 12.12	309 46 23	Long Point	129 47 23	3327.7	3639.1	2.07
			338 40 47	Deep Creek Point	158 41 02	1753.0	1917.0	1.09

United States Coast Survey.—Geographical Positions. Section IV.—Alligator River. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
ALLIGATOR RIVER.	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Sandy Point	35 55 24.93	E. 0 10 45.02	172 52 17	Long Shoal	352 52 05	4136.2	4523.2	2.57
			234 22 23	West Durant Island	54 24 34	6870.7	7513.6	4.27
South Durant	35 56 07.49	0 16 14.17	80 59 19	Sandy Point	260 56 06	8354.5	9136.2	5.19
			107 42 05	Long Shoal	287 38 40	9196.2	10056.7	5.71
Little Alligator	35 57 15.93	0 10 13.46	202 06 46	Long Shoal	22 06 53	737.4	806.4	0.46
			346 58 36	Sandy Point	166 58 55	3511.0	3839.5	2.18
Briery Hall	35 55 38.69	0 15 13.98	162 06 08	West Durant Island	342 05 41	3757.8	4109.4	2.33
			86 25 06	Sandy Point	266 22 28	6755.8	7387.9	4.20
A	35 55 08.25	E. 0 14 28.83	127 02 30	Long Shoal	307 00 07	7669.4	8387.0	4.76
			179 42 09	West Durant Island	359 42 09	4514.3	4936.7	2.79
B	35 54 16.01	E. 0 13 44.13	141 14 21	Long Shoal	321 12 24	7988.6	8736.1	4.96
			115 19 28	Sandy Point	295 17 43	4967.6	5432.4	3.08
Laurel Point	35 53 15.35	0 11 52.68	164 44 32	Long Shoal	344 43 40	8393.7	9179.1	5.21
			156 59 06	Sandy Point	336 58 27	4338.9	4744.9	2.69
Second Creek	35 52 12.71	0 08 45.95	206 44 03	Sandy Point	26 45 13	6634.2	7255.0	4.12
			247 34 38	Laurel Point	67 36 27	5066.2	5540.2	3.14
C	35 53 44.18	0 12 29.22	63 17 30	Second Creek	343 15 19	6269.6	6856.2	3.89
			139 55 33	Sandy Point	319 54 32	4058.1	4437.8	2.52
Y	35 54 08.63	E. 0 09 40.74	296 22 42	Laurel Point	116 23 59	3693.6	4039.2	2.29
			21 02 23	Second Creek	201 01 51	3827.9	4186.0	2.37

United States Coast Survey.—Geographical Positions. Section IV.—Alligator River. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Lot Signal	35 48 05.87	E. 0 08 24.76	183 59 37	Second Creek	3 59 50	7626.2	8339.8	4.73
			208 39 26	Laurel Point	28 41 27	10872.0	11889.3	6.75
X	35 51 01.43	0 07 44.20	236 27 48	Laurel Point	56 30 14	7476.0	8175.5	4.64
			304 35 53	Cypress Point	124 38 16	7438.2	8134.2	4.62
E	35 50 29.74	0 12 27.79	54 00 17	Lot Signal	233 57 55	7541.6	8247.2	4.68
			119 42 19	Second Creek	299 40 09	6407.2	7006.7	3.98
D	35 52 04.02	0 11 50.12	35 05 19	Lot Signal	215 03 20	8968.6	9807.8	5.57
			93 19 41	Second Creek	273 17 54	4627.8	5060.8	2.88
F	35 49 35.17	0 12 12.17	64 16 34	Lot Signal	244 14 21	6337.7	6930.7	3.94
			133 11 23	Second Creek	313 09 22	7095.9	7759.9	4.41
W	35 49 39.53	0 07 44.38	223 05 51	Laurel Point	43 08 16	9113.6	9966.4	5.66
			285 31 20	Cypress Point	105 33 43	6349.6	6943.7	3.95
Cypress Point	35 48 44.31	0 11 48.09	144 34 29	Second Creek	324 32 42	7863.2	8599.0	4.89
			180 47 08	Laurel Point	0 47 10	8354.6	9136.3	5.19
Frying Pan	35 45 00.98	0 08 39.38	180 42 56	Second Creek	0 43 00	13306.8	14551.9	8.27
			176 20 02	Lot Signal	356 19 54	5710.1	6244.4	3.55
Poplar Ridge	35 43 17.56	0 11 11.68	154 44 54	Lot Signal	334 43 17	9825.4	10744.8	6.10
			129 46 58	Frying Pan	309 45 29	4982.4	5448.6	3.10
G	35 46 57.99	0 12 13.29	56 09 26	Frying Pan	236 07 21	6473.0	7078.7	4.02
			110 02 47	Lot Signal	290 00 33	6108.0	6679.5	3.80
Stokes' Store, (west gable end.)	35 46 49.03	E. 0 12 16.94	58 40 10	Frying Pan	238 38 03	6401.6	7000.6	3.99
			112 07 23	Lot Signal	292 05 07	6293.0	6878.9	3.91

United States Coast Survey.—Geographical Positions. Section IV.—Alligator River. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
H	35 45 20.33	E. 0 11 56.38	83 08 42	Frying Pan	263 06 47	4987.3	5454.0	3.10
			133 50 38	Lot Signal	313 48 34	7367.4	8056.8	4.58
U	35 45 52.33	0 08 21.98	224 17 43	Cypress Point	44 19 44	7408.2	8101.4	4.60
			318 11 26	Poplar Ridge	138 13 05	6397.7	6996.3	3.98
Q	35 42 12.18	0 08 52.72	176 16 59	Frying Pan	356 16 51	5213.4	5701.2	3.24
			240 00 18	Poplar Ridge	60 01 39	4032.2	4409.5	2.51
R	35 43 31.81	0 09 07.36	165 35 55	Frying Pan	345 35 39	2837.2	3102.7	1.76
			277 59 33	Poplar Ridge	98 00 46	3155.0	3450.2	1.96
S	35 42 28.19	0 08 29.96	182 51 24	Frying Pan	2 51 29	4693.3	5132.5	2.92
			249 43 47	Poplar Ridge	69 45 21	4332.5	4737.9	2.69
T	35 43 55.42	0 09 03.36	163 19 46	Frying Pan	343 19 32	2109.4	2306.8	1.31
			289 52 45	Poplar Ridge	109 54 00	3429.3	3750.2	2.13
Newport News	35 41 24.00	0 09 12.09	172 58 13	Frying Pan	352 57 54	6737.8	7368.3	4.19
			220 38 55	Poplar Ridge	40 40 05	4613.6	5045.3	2.87
J	35 42 18.91	0 11 17.12	61 42 28	Newport News	241 41 15	3569.9	3903.9	2.22
			141 33 20	Frying Pan	321 31 48	6378.2	6975.0	3.96
K	35 41 32.24	0 11 00.73	84 41 34	Newport News	264 40 31	2743.2	2999.9	1.70
			151 05 03	Frying Pan	331 03 40	7350.1	8037.9	4.57
I	35 43 55.08	0 11 36.03	37 51 28	Newport News	217 50 04	5896.7	6448.5	3.66
			114 35 15	Frying Pan	294 33 32	4883.5	5340.5	3.03
L	35 40 14.11	E. 0 10 29.73	137 48 59	Newport News	317 48 14	2907.2	3179.2	1.81
			190 33 31	Poplar Ridge	10 33 55	5751.4	6289.6	3.57

United States Coast Survey.—Geographical Positions. Section IV.—Croatan Sound. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Cove Signal	35 39 21.59	E. 0 10 02.56	161 24 14	Newport News	341 23 45	3980.4	4352.9	2.47
			193 25 46	Poplar Ridge	13 26 27	7477.0	8176.5	4.65
M	35 39 03.01	0 09 15.73	178 47 14	Newport News	358 47 12	4346.2	4752.8	2.70
			244 03 47	Cove Signal	64 04 14	1309.7	1432.3	0.81
O	35 39 35.58	0 08 43.70	208 31 23	Poplar Ridge	28 32 49	7787.4	8512.8	4.84
			282 15 01	Cove Signal	102 15 47	2029.9	2219.8	1.26
P	35 40 20.33	E. 0 08 56.01	211 58 03	Poplar Ridge	31 59 22	6439.4	7041.9	4.00
			317 14 02	Cove Signal	137 14 41	2465.5	2696.2	1.53
CROATAN SOUND.								
Midget	35 58 07.60	E. 0 21 24.20	247 45 39	Roden	67 49 17	10056.8	10997.8	6.24
			298 47 54	Carroon's Point	118 48 51	2802.0	3064.2	1.74
Robert's Fishery	35 56 06.08	0 24 26.03	138 44 18	Carroon's Point	318 43 29	3185.7	3483.7	1.97
			212 12 42	Roden	32 14 33	8920.1	9754.7	5.54
Robert's Fishery, (2)	35 56 06.67	0 24 27.17	138 08 40	Carroon's Point	318 07 50	3191.4	3490.0	1.98
			212 06 59	Roden	32 08 50	8890.0	9721.8	5.52
West End of Roanoke	35 56 06,26	0 27 40.23	108 56 47	Carroon's Point	288 54 04	7366.5	8055.7	4.57
			179 10 24	Roden	359 10 21	7541.3	8246.9	4.68
Dow	35 56 26.40	0 28 17.88	102 37 27	Carroon's Point	282 34 22	8106.6	8865.1	5.03
			171 21 35	Roden	251 21 11	6999.2	7654.1	4.34
Mann's Hill	35 56 10.19	E. 0 29 29.47	103 10 57	Carroon's Point	283 07 14	9967.4	10900.0	6.19
			159 01 31	Roden	339 00 24	7946.2	8689.7	4.93

United States Coast Survey.—Geographical Positions. Section IV.—Currituck Sound. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ″ ′	*Metres.*	*Yards.*	*Miles.*
Fleet Wood	35 52 59.29	E. 0 26 31.66	151 36 54	Robert's Fishery	331 35 41	6564.6	7178.8	4.07
			196 36 17	West End of Roanoke	16 36 58	6013.7	6576.4	3.73
Weir Point	35 55 31.93	0 27 59.60	25 07 03	Fleet Wood	205 06 12	5195.8	5681.9	3.22
			101 22 43	Robert's Fishery	281 20 40	5431.6	5939.8	3.37
Pork Point	35 52 59.44	0 30 28.51	89 58 13	Fleet Wood	269 55 54	5940.6	6496 5	3.69
			141 32 38	Weir Point	321 31 11	6002.5	6564.2	3.72
Red Stone	35 54 35.14	0 25 32.24	244 37 56	Weir Point	64 39 22	4088.1	4470.6	2.54
			149 57 32	Robert's Fishery	329 56 54	3258.4	3563.3	2.02
Callaghan's Creek	35 50 47.78	0 26 58.21	170 39 51	Fleet Wood	350 39 35	4107.5	4491.8	2.55
			232 24 47	Pork Point	52 26 50	6655.7	7278.4	4.13
Baum's Creek	35 50 41.93	E. 0 31 26.86	160 56 37	Pork Point	340 56 03	4484.0	4903.5	2.78
			119 46 26	Fleet Wood	299 43 33	8530.7	9328.9	5.30
CURRITUCK SOUND.								
SHELL BANK	36 03 20.93	E. 0 26 57.96	....	....	....	....	....	....
POWELL'S POINT	36 04 18.83	0 23 26.73	....	....	....	....	....	....
Kill Devil Hill	36 01 07.05	0 31 17.91	122 24 03	Shell Bank	302 21 30	7702.5	8423.2	4.79
			116 39 32	Powell's Point	296 34 55	13190.5	14424.7	8.20
Sampson's Point	36 04 49.08	0 23 58.90	357 35 04	Robert's Fishery	177 35 20	16132.3	17641.8	10.02
			301 12 57	Shell Bank	121 14 43	5239.2	5729.4	3.26
Paul Gamiel's Hill	36 09 16.29	E. 0 26 39.91	27 48 19	Powell's Point	207 46 25	10361.6	11331.3	6.44
			26 03 55	Sampson's Point	206 02 20	9166.6	10024.3	5.70

United States Coast Survey.—Geographical Positions. Section IV.—Roanoke Island and Bodie's Island. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Martin's Point	36 07 31.62	E. 0 26 16.20	35 31 09	Powell's Point	215 29 30	7297.8	7980.7	4.53
			34 26 17	Sampson's Point	214 24 56	6073.1	6641.4	3.77
Pig Point	36 06 48.26	0 23 33.68	251 47 04	Martin's Point	71 48 40	4277.5	4677.7	2.66
			321 19 58	Shell Bank	141 21 58	8181.5	8947.1	5.08
Thoroughfare Island	36 09 38.31	0 22 33.54	305 02 03	Martin's Point	125 04 14	6798.5	7434.6	4.22
			276 16 04	Paul Gamiel's Hill	96 18 30	6194.4	6774.0	3.85
North Banks	36 11 52.05	0 25 44.93	354 26 17	Martin's Point	174 26 35	8064.1	8818.7	5.01
			344 01 24	Paul Gamiel's Hill	164 01 57	4992.9	5460.1	3.10
Hog Quarter Windmill	36 07 19.34	0 22 50.33	174 24 20	Thoroughfare Island	354 24 10	4303.2	4705.9	2.67
			265 46 34	Martin's Point	85 48 35	5161.0	5643.9	3.21
Poke Point	36 13 07.44	0 20 19.28	285 54 55	North Banks	105 58 07	8458.6	9250.1	5.26
			332 29 46	Thoroughfare Island	152 31 05	7265.4	7945.2	4.51
Jew's Quarter	36 11 22.51	E. 0 21 36.20	261 38 30	North Banks	81 40 57	6279.6	6867.2	3.90
			335 57 03	Thoroughfare Island	155 57 36	3516.1	3845.1	2.19
ROANOKE ISLAND AND BODIE'S ISLAND.								
North End of Base	35 53 56.56	E. 0 35 32.90	....	....	....	....	....	....
South End of Base	35 48 34.03	0 38 25 45	156 28 48	North End of Base	336 27 07	10841.5	11855.9	6.735
Shallow Back Bay	35 55 08.19	E. 0 31 52.78	172 48 05	Mann's Point	352 47 48	5784.8	6326.0	3.59
			291 47 18	North End of Base	111 49 28	5944.5	6500.7	3.69

United States Coast Survey.—Geographical Positions. Section IV.—Roanoke Island and Bodie's Island. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Meekin's Mill...............	35 51 28.60	E. 0 33 10.23	218 07 14	North End of Base..........	38 08 38	5795.8	6338.1	3.60
			304 11 49	South End of Base..........	124 14 54	9567.3	10462.5	5.94
Roanoke Island, south end...	35 49 58.25	0 34 20.14	193 57 26	North End of Base..........	13 58 09	7566.7	8274.7	4.70
			292 50 40	South End of Base..........	112 53 04	6682.7	7308.2	4.15
Jacock	35 56 35.47	0 33 58.59	275 13 21	Carroon's Point............	275 06 57	16516.9	18062.3	10.26
			88 08 58	Dow........................	268 05 38	8543.7	9343.1	5.30
Sugar Wreck................	35 54 38.86	0 35 41.05	8 54 40	North End of Base..........	188 54 35	1319.3	1442.7	0.81
			63 10 38	No. 4......................	243 09 39	2816.6	3080.1	1.74
Nag's Head.................	35 55 43.68	0 34 44.19	324 29 02	Sugar Wreck................	144 29 35	2454.0	2683.6	1.52
			339 41 35	North End of Base..........	159 42 03	2519.6	3848.9	2.18
First Mile Stone...........	35 53 08.73	0 35 58.52	156 27 22	North End of Base..........	336 27 07	1608.0	1758.4	1.00
Second Mile Stone	35 52 20.90	0 36 24.13	156 27 37	First Mile Stone...........	336 27 22	1608.0	1758.4	1.00
Beach Signal...............	35 53 41.79	0 36 14.52	113 34 32	North End of Base..........	293 34 08	1138.7	1245.2	0.70
			354 28 53	Second Mile Stone..........	174 28 54	2504.6	2738.9	1.55
Tent Pole..................	35 51 51.34	0 36 57.71	148 06 16	First Mile Stone	328 05 41	2809.4	3072.2	1.74
			137 14 39	Second Mile Stone..........	317 14 19	1240.8	1356.8	0.77
Third Mile Stone...........	35 51 33.06	0 36 49.73	156 27 52	Second Mile Stone..........	336 27 37	1608.0	1758.4	1.00
			199 34 23	Tent Pole	19 34 28	597.8	653.7	0.37
No. 1......................	35 51 02.44	E. 0 36 11.52	187 26 50	Second Mile Stone..........	7 26 57	2438.6	2666.7	1.51
			225 26 07	Third Mile Stone...........	45 26 30	1345.1	1470.9	0.84

United States Coast Survey.—Geographical Positions. Section IV.—Bodie's Island. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
No. 2	35 51 51.90	E. 0 35 37.48	232 37 39	Second Mile Stone	52 38 06	1472.2	1609.9	0.91
			287 45 20	Third Mile Stone	107 46 02	1903.1	2081.1	1.18
No. 3	35 52 58.36	0 34 51.30	210 10 58	North End of Base	30 11 22	2075.0	2269.1	1.28
			259 15 49	First Mile Stone	79 16 28	1716.0	1876.5	1.06
No. 4	35 53 57.61	0 34 00.80	270 47 15	North End of Base	90 48 09	2309.4	2525.4	1.44
			297 01 23	First Mile Stone	117 02 32	3313.9	3623.9	2.06
Fourth Mile Stone	35 50 45.23	0 37 15.32	156 28 07	Third Mile Stone	336 27 52	1608.0	1758.4	1.00
Fifth Mile Stone	35 49 57.40	0 37 40.90	156 28 22	Fourth Mile Stone	336 28 07	1608.0	1758.4	1.00
Sixth Mile Stone	35 49 09.55	0 38 06.47	336 28 37	South End of Base	156 28 48	1194.1	1305.8	0.74
			156 28 37	Fifth Mile Stone	336 28 22	1608.0	1758.4	1.00
Tommy's Hammock	35 50 47.54	0 36 50.73	324 50 04	Fifth Mile Stone	140 50 33	1993.5	2180.0	1.23
			178 58 31	Third Mile Stone	358 58 30	1403.1	1534.3	0.87
Four Wrecks Signal	35 51 04.74	0 37 33.65	128 23 38	Third Mile Stone	308 23 12	1405.9	1537.4	0.87
			354 59 23	Fifth Mile Stone	177 59 27	2083.5	2278.4	1.29
Barrel Head	35 49 55.46	0 38 11.41	137 27 39	Fourth Mile Stone	317 27 06	2081.7	2276.4	1.29
			5 00 19	Fifth Mile Stone	185 00 16	768.0	839.8	0.49
Cedar Point	35 49 06.28	0 37 04.62	210 01 48	Fifth Mile Stone	30 02 09	1819.4	1989.6	1.12
			266 16 55	Sixth Mile Stone	86 17 31	1555.8	1701.3	0.97
Cut-off Point	35 48 25.52	E. 0 37 18.91	261 05 02	South End of Base	81 05 41	1690.9	1849.1	1.05
			164 03 42	Cedar Point	344 03 26	1306.2	1428.4	0.81

United States Coast Survey.—Geographical Positions. Section IV.—Bodie's Island. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Howard Signal	35 49 11.88	E. 0 38 36.38	53 42 18	Cut-off Point	233 41 33	2412.9	2638.6	1.49
			84 32 02	Sixth Mile Stone	264 31 45	754.1	824.6	0.46
North Duck Island	35 48 17.10	0 35 30.94	237 11 22	Cedar Point	57 12 17	2797.4	3059.1	1.73
			264 31 13	Cut-off Point	84 32 16	2722.7	2977.4	1.69
South Duck Island	35 47 40.09	0 36 04.93	209 25 18	Cedar Point	29 25 53	3049.4	3334.7	1.89
			232 58 52	Cut-off Point	52 59 35	2325.7	2543.3	1.44
North Point	35 48 13.57	0 39 09.50	97 34 08	Cut-off Point	277 33 03	2800.6	3062.6	1.73
			19 41 32	South end of Base	299 41 06	1272.6	1391.6	0.79
Bodie's Island Light-house	35 47 20.54	0 39 23.79	160 52 27	Howard Signal	340 51 59	3631.6	3971.4	2.25
			147 06 54	South end of Base	327 06 20	2696.7	2949.0	1.67
Midget	35 47 32.93	0 39 40.80	92 20 49	South Duck Island	272 18 43	5424.5	5932.0	3.37
			134 52 15	South End of Base	314 51 30	2668.8	2918.5	1.65
Green Island	35 45 57.80	0 39 13.61	165 54 18	South End of Base	345 53 50	4963.8	5428.2	3.08
			193 06 36	Midget	13 06 52	3010.2	3291.8	1.89
Wreck Safford	35 45 39.33	0 40 56.23	102 27 36	Green Island	282 26 36	2639.5	2886.5	1.64
			151 35 26	Midget	331 34 41	3980.3	4352.7	2.47
Salt Pump	35 46 48.84	0 39 49.31	321 52 28	Wreck Safford	141 53 07	2722.6	2977.4	1.69
			29 41 12	Green Island	209 40 51	1810.3	1979.7	1.12
Eagle Nest Point	35 44 10.55	0 40 17.58	154 04 36	Green Island	334 03 59	3675.1	4019.0	2.28
			119 32 03	Wreck Safford	19 32 26	2903.2	3174.9	1.80
Gar Island	35 45 10.52	E. 0 39 54.48	144 50 33	Green Island	324 50 09	1782.4	1949.2	1.11
			342 33 39	Eagle Nest Point	162 33 53	1936.9	2118.1	1.20

United States Coast Survey.—Geographical Positions. Section IV.—New Inlet to Cape Hatteras. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Ethridge's House	35 44 32.61	E. 0 41 16.09	65 10 53	Eagle Nest Point	245 10 19	1619.6	1771.2	1.01
			166 21 46	Wreck Safford..............	346 21 34	2115.8	2313.8	1.31
Brig Adams	35 43 56.40	0 41 44.80	101 15 43	Eagle Nest Point	281 14 51	2234.6	2443.7	1.39
			158 57 44	Wreck Safford..............	338 57 16	3398.8	3716.8	2.11
Pea Island	35 42 37.44	0 40 41.37	168 13 56	Eagle Nest Point	348 13 42	2931.0	3205.3	1.82
			213 13 29	Brig Adams	33 14 06	2908.9	3181.1	1.81
Little Pea Island...........	35 43 14.21	0 40 33.68	166 53 03	Eagle Nest Point	346 52 54	1782.8	1949.6	1.11
			233 57 29	Brig Adams	53 58 11	2210.1	2416.9	1.37
Pea Island Main	35 43 06.35	0 41 20.61	201 30 48	Brig Adams	21 31 02	1657.8	1812.9	1.03
			47 54 37	Pea Island.................	47 54 14	1329.0	1453.4	0.83
New Inlet, North Point	35 42 00.54	0 42.20.40	114 33 47	Pea Island.................	294 22 49	2736.7	2992.8	1.70
			165 56 07	Brig Adams	345 55 46	3680.9	4025.3	2.29
Jack Shoal	35 41 08.97	0 41 14 02	163 14 59	Pea Island.................	343 14 40	2847.1	3113.5	1.77
			226 23 57	New Inlet, North Point.......	46 24 36	2304.4	2520.0	1.43
New Inlet, South Point	35 41 03.90	E. 0 42 35.62	124 49 48	Jack Shoal	304 48 54	2057.6	2250.1	1.28
			168 39 02	New Inlet, North Point.......	348 38 47	1786.9	1954.1	1.11
FROM NEW INLET TO CAPE HATTERAS.								
South of New Inlet Signal...	35 40 16.81	E. 0 42 45 93	94 22 01	Jack Shoal	274 21 13	2815.1	3078.5	1.75
			167 38 20	New Inlet, North Point.......	347 38 11	3260.3	3565.4	2.03
Loggerhead Inlet	35 38 14.74	E. 0 42 47.23	155 58 28	Jack Shoal	335 57 33	5879.0	6429.1	3.65
			178 44 16	South of New Inlet..........	358 44 14	3762.7	4114.8	2.34

United States Coast Survey.—Geographical Positions. Section IV.—New Inlet to Cape Hatteras. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Loggerhead Shoal	35 37 59.39	E. 0 42 13.63	242 09 20	Loggerhead Inlet	62 09 41	1012.5	1107.3	0.63
			190 51 04	South of New Inlet	10 51 23	4312.1	4715.6	2.68
Chickamicomico North	35 36 11.26	0 43 43.43	145 52 08	Loggerhead Shoal	325 51 16	4025.7	4402.4	2.50
			160 17 08	Loggerhead Inlet	340 16 37	4041.8	4420.0	2.51
Wind Mill	35 35 52.54	0 43 03.52	175 18 36	Loggerhead Inlet	355 18 28	4396.8	4808.2	2.73
			240 07 11	Chickamicomico North	60 07 35	1158.4	1266.7	0.71
Chickamicomico Main	35 34 46.74	0 43 19.81	192 51 17	Chickamicomico North	12 51 30	2671.6	2921.5	1.65
			168 33 54	Windmill	348 33 45	2068.7	2262.2	1.28
Chickamicomico, (2)	35 35 08.02	0 43 49.73	139 42 45	Windmill	319 42 18	1798.7	1967.0	1.11
			48 57 31	Chickamicomico Main	228 57 14	998.5	1091.9	0.62
Chickamicomico, (3)	35 34 17.60	0 43 46.98	142 42 29	Chickamicomico Main	322 42 13	1129.0	1234.9	0.73
			182 32 45	Chickamicomico, (2)	2 32 46	1555.3	1700.8	0.96
Chickamicomico, (4)	35 32 44.97	0 43 33.14	174 53 24	Chickamicomico Main	354 53 16	3767.7	4120.5	2.34
			186 57 36	Chickamicomico, (5)	6 57 45	2875.8	3144.8	1.78
Opening Marsh	35 33 05.64	0 42 54.39	210 50 19	Chickamicomico, (3)	30 50 50	2582.9	2824.5	1.60
			303 08 02	Chickamicomico, (4)	123 08 24	1165.4	1274.4	0.72
Wreck Dolphin	35 31 20.21	0 43 05.94	174 53 07	Opening Marsh	354 53 03	3261.9	3567.1	2.03
			194 41 49	Chickamicomico, (4)	14 42 05	2700.2	2952.8	1.67
No Egg Point	35 31 47.58	0 42 21.57	225 08 29	Chickamicomico, (4)	45 09 10	2507.1	2741.6	1.55
			307 39 08	Wreck Dolphin	127 39 33	1380.0	1509.3	0.85
Cedar Hammock Island	35 30 37.81	E. 0 42 01.55	193 50 08	No Egg Point	13 50 20	2213.9	2421.0	1.38
			231 08 42	Wreck Dolphin	51 09 20	2082.9	2277.8	1.29

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United States Coast Survey.—Geographical Positions. Section IV.—New Inlet to Cape Hatteras. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Bay Signal	35 29 49.51	E. 0 42 47.88	141 53 58	Cedar Hammock Island	321 53 31	1891.7	2068.7	1.17
			189 14 43	Wreck Dolphin	9 14 54	2831.9	3096.8	1.76
Myrtle Signal	35 28 16.91	0 42 33.91	169 22 00	Cedar Hammock Island	349 21 41	4418.0	4831.4	2.74
			92 55 53	Gull Island	272 54 15	4271.0	4670.6	2.65
Gull Island	35 28 23.97	0 39 44.70	240 15 37	Bay Signal	60 17 24	5316.4	5813.8	3.30
			219 53 27	Cedar Hammock Island	39 54 47	5376.6	5879.6	3.34
Little Hill	35 26 20.03	0 42 26.13	183 06 57	Myrtle Signal	3 07 02	3607.1	3944.6	2.24
			133 11 26	Gull Island	313 09 53	5581.5	6103.7	3.46
Drain Island	35 25 56.75	0 41 48.79	194 45 09	Myrtle Signal	14 45 36	4466.6	4884.5	2.78
			232 41 47	Little Hill	52 52 09	1184.0	1294.7	0.73
Bald Beach	35 25 18.87	0 42 23.38	143 13 40	Drain Island	323 13 19	1457.3	1593.6	0.90
			182 06 30	Little Hill	2 06 32	1886.0	2062.4	1.17
Terrapin Point	35 24 46.15	0 41 44.00	183 10 43	Drain Island	3 10 45	2178.8	2382.6	1.35
			224 34 31	Bald Beach	44 34 54	1415.3	1547.7	0.87
Barnes' Signal	35 24 27.03	0 42 18.27	124 16 45	Terrapin Point	304 16 25	1046.4	1144.3	0.65
			184 36 34	Bald Beach	4 36 37	1602.6	1752.6	0.99
Bog Channel	35 23 56.28	0 41 32.14	191 00 49	Terrapin Point	11 00 56	1565.7	1712.2	0.97
			230 50 53	Barnes' Signal	50 51 19	1500.8	1641.2	0.93
Bog Opening	35 23 17.38	0 41 58.15	151 18 26	Bog Channel	331 18 11	1366.7	1494.6	0.85
			193 18 33	Barnes' Signal	13 18 45	2205.6	2412.0	1.37
Old Tree	35 22 43.74	E. 0 41 27.23	183 10 24	Bog Channel	3 10 27	2239.0	2448.5	1.39
			216 57 47	Bog Opening	36 58 05	1297.5	1418.9	0.81

United States Coast Survey.—Geographical Positions. Section IV.—New Inlet to Cape Hatteras. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Stowe	35 22 27.74	E. 0 41 46.61	135 13 12	Old Tree	315 13 00	694.5	759.5	0.43
			190 46 29	Bog Opening	10 46 36	1557.1	1702.8	0.97
Mill Creek	35 22 04.06	0 41 06.74	202 55 11	Old Tree	22 55 23	1327.7	1451.9	0.82
			234 02 31	Stowe	54 02 54	1243.2	1359.5	0.77
Scarborough	35 21 16.89	0 41 18.78	168 11 21	Mill Creek	348 11 14	1484.9	1623.8	0.92
			197 49 52	Stowe	17 50 08	2293.7	2508.3	1.42
Lookout, (1)	35 21 08.66	0 40 32.70	206 43 15	Mill Creek	26 43 34	1911.1	2089.9	1.19
			257 42 39	Scarborough	77 43 05	1190.6	1302.0	0.74
Lookout, (2)	35 20 38.25	0 40 59.79	143 52 46	Lookout, (1)	323 52 30	1160.3	1268.9	0.72
			201 55 59	Scarborough	21 56 10	1283.5	1403.6	0.80
Barnes' Mill	35 20 04.26	0 40 18.95	189 55 16	Lookout, (1)	9 55 24	2015.0	2203.6	1.25
			224 32 54	Lookout, (2)	44 33 17	1470.0	1607.6	0.91
Lookout, (3)	35 20 06.93	0 40 58.26	85 15 00	Barnes' Mill	265 14 37	995.9	1089.1	0.62
			182 18 24	Lookout, (2)	2 18 25	965.9	1056.3	0.60
Long Point	35 18 38.77	0 40 21.37	178 40 11	Barnes' Mill	358 40 10	2634.9	2881.4	1.64
			198 55 22	Lookout, (3)	18 55 43	2872.0	3140.7	1.78
Jardella	35 18 12.28	0 40 56.11	164 47 01	Barnes' Mill	344 46 40	3575.9	3910.5	2.22
			132 55 35	Long Point	312 55 15	1198.7	1310.9	0.74
Log	35 16 54.71	0 40 50.87	166 54 55	Long Point	346 54 37	3292.0	3600.0	2.05
			183 10 12	Jardella	3 10 15	2393.9	2617.9	1.49
Palmetto	35 16 10.34	E. 0 39 44.97	191 21 57	Long Point	11 22 17	4665.4	5101.9	2.90
			230 36 39	Log	50 37 18	2154.8	2356.4	1.34

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Last Signal	35 15 51.12	E. 0 40 45.39	111 12 13	Palmetto	291 11 38	1637.9	1791.2	1.02
			184 02 38	Log	4 02 41	1964.4	2148.2	1.22
CAPE HATTERAS TO OCRACOKE INLET.								
Cape Hatteras Light-house	35 15 11.08	E. 0 40 09.36	161 20 37	Palmetto	341 20 23	1927.5	2107.8	1.19
			216 25 23	Last Signal	36 25 44	1533.5	1676.9	0.95
A	35 14 45.00	0 40 34.99	141 07 43	Light-house	321 07 28	1032.2	1128.7	0.64
			187 20 58	Last Signal	7 21 10	2054.4	2246.6	1.27
Cove Point	35 13 39.59	0 39 51.86	208 24 24	A	28 23 58	2292.3	2516.7	1.42
			188 55 07	Light-house	8 55 17	2853.9	3120.9	1.77
King's Point	35 16 11.73	0 35 16.56	284 08 57	Light-house	104 11 47	7632.9	8347.1	4.74
			226 48 24	Barnes' Mill	46 51 18	10473.0	11452.9	6.51
Jannet's Mill	36 16 16.60	0 38 52.95	88 26 51	King's Point	268 24 46	5470.5	5982.4	3.40
			197 11 46	Barnes' Mill	17 12 35	7343.8	8030.9	4.56
Bare Hill	35 13 25.51	0 32 37.86	218 03 17	King's Point	38 04 48	11869.0	12979.6	7.38
			254 03 23	Light-house	74 07 44	6506.3	7115.1	4.04
Egg Shoal	35 15 29.56	0 28 28.09	301 10 08	Bare Hill	121 12 32	7381.3	8071.9	4.59
			262 47 33	King's Point	82 51 29	10404.7	11378.3	6.47
Duran's Point	35 14 02.74	0 30 35.35	290 18 18	Bare Hill	110 19 57	3303.1	3612.2	2.05
			129 45 18	Egg Shoal	309 44 06	4184.1	4575.6	2.60
Porpoise	35 12 25.60	E. 0 30 11.90	155 09 46	Egg Shoal	335 08 47	6247.0	6831.6	3.88
			227 50 17	King's Point	47 53 12	10386.3	11358.2	6.45

United States Coast Survey.—Geographical Positions. Section IV.—Cape Hatteras to Ocracoke Inlet. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
East Inlet	35 11 52.80	E. 0 27 50.75	188 02 30	Egg Shoal	8 02 51	6746.0	7377.2	4.19
			254 10 50	Porpoise	74 12 11	3710.4	4057.6	2.31
West Inlet	35 11 08.59	0 26 22.63	201 31 04	Egg Shoal	21 32 16	8644.8	9453.7	5.37
			247 43 42	Porpoise	67 45 54	6265.9	6852.2	3.89
Legged Lump	35 12 17.87	0 21 33 90	286 16 16	West Inlet	106 19 03	7609.0	8321.4	4.73
			240 32 28	Egg Shoal	60 36 27	12023.0	13148.0	7.47
Wells' Creek	35 10 07.25	0 23 15.55	147 26 07	Legged Lump	327 25 09	4776.5	5223.4	2.97
			248 12 50	West Inlet	68 14 37	5096.7	5573.6	3.17
Clark's Reef	35 09 45.77	0 18 07.34	265 07 32	Wells' Creek	85 10 29	7826.8	8559.1	4.86
			228 05 35	Legged Lump	48 07 36	7019.4	7676.2	4.36
Great Swash	35 08 52.96	0 19 01.68	139 48 07	Clark's Reef	319 47 35	2130.3	2329.7	1.32
			250 22 10	Wells' Creek	70 24 37	6820.0	7458.2	4.24
1st Hammock Hill	35 07 14.52	0 15 10.88	242 32 28	Great Swash	62 34 43	6583.0	7199.0	4.09
			223 46 00	Clark's Reef	43 47 40	6455.3	7059.3	4.01
Our Reef	35 08 39.32	0 12 53.77	306 57 59	1st Hammock Hill	126 59 17	4344.6	4751.1	2.70
			255 30 26	Clark's Reef	75 33 27	8195.6	8962.4	5.09
Ocracoke Light-house	35 06 31.63	0 12 16.08	253 21 40	1st Hammock Hill	73 23 21	4618.8	5050.9	2.87
			193 37 36	Our Reef	13 37 58	4048.7	4427.5	2.52
Middle Ground	35 05 33.61	0 11 01.48	206 24 29	Our Reef	26 25 34	6389.9	6987.8	3.97
			243 45 56	1st Hammock Hill	63 48 19	7039.1	7697.8	4.37
Beacon Island	35 06 02.87	E. 0 08 38.48	283 58 09	Middle Ground	103 59 31	3732.2	4081.4	2.32
			233 15 37	Our Reef	53 18 04	8063.2	8817.7	5.01

United States Coast Survey.—Geographical Positions. Section IV.—Cape Hatteras to Ocracoke Inlet. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
East Portsmouth	35 03 55.31	E. 0 08 38.73	179 54 20	Beacon Island	359 54 20	3930.5	4298.3	2.44
			230 02 17	Middle Ground	50 03 39	4716.9	5158.2	2.93
Shell Island	35 06 10.71	0 06 36.01	323 18 06	East Portsmouth	143 19 17	5202.8	5689.7	3.23
			274 26 41	Beacon Island	94 27 52	3110.7	3401.8	1.93
Portsmouth Castle	35 05 50.54	0 07 06.23	326 34 18	East Portsmouth	146 35 11	4254.0	4652.1	2.64
			260 45 20	Beacon Island	80 46 13	2366.8	2588.2	1.47
Portsmouth Steeple	35 04 09.34	E. 0 07 45.40	154 50 10	Shell Island	334 49 30	4132.4	4519.1	2.57
			201 01 05	Beacon Island	21 01 35	3747.9	4098.6	2.33

United States Coast Survey.—Geographical Positions. Section V.—Charleston Harbor. Sketch E.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
CHARLESTON HARBOR.	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Breach Inlet	32 46 19.27	79 48 43.02	.....	.....	.....	.....	.....	.....
Circular Church	32 46 42.53	79 55 38.77	273 45 29	Breach Inlet	93 49 14	10842.1	11856.6	6.74
Vincent	32 43 42.51	79 51 48.67	225 00 29	Breach Inlet	45 02 09	6831.2	7470.4	4.25
			132 48 50	Circular Church	312 46 46	8161.9	8925.6	5.07
Mount Pleasant	32 47 13.39	79 52 37.61	348 54 06	Vincent	168 54 33	6619.3	7238.7	4.11
			78 36 50	Circular Church	258 35 12	4808.4	5258.3	2.99
Fort Johnson	32 45 09.48	79 53 34.77	314 07 02	Vincent	134 07 59	3847.7	4207.7	2.39
			131 37 30	Circular Church	311 36 23	4316.3	4720.2	2.68
Castle Pinckney	32 46 23.92	79 54 25.07	270 53 48	Breach Inlet	90 56 53	8902.2	9735.2	5.53
			241 24 12	Mount Pleasant	61 25 10	3184.3	3482.3	1.98
Styles	32 45 10.70	79 55 34.41	177 42 19	Circular Church	357 42 17	2830.9	3095.8	1.76
			218 39 42	Castle Pinckney	38 40 20	2888.4	3158.7	1.80
Hobcaw	32 48 47.23	79 54 11.55	30 34 43	Circular Church	210 33 56	4461.1	4878.5	2.77
			4 33 33	Castle Pinckney	184 33 25	4428.3	4842.7	2.75
North Base	32 48 48.83	79 56 51.32	334 06 35	Circular Church	154 07 15	4324.0	4728.6	2.69
			270 40 00	Hobcaw	90 41 27	4156.2	4545.1	2.58
South Base	32 47 46.38	79 56 14.84	334 28 33	Circular Church	154 28 53	2179.0	2372.9	1.36
			153 44 55	North Base	333 44 36	2145.0	2345.7	1.33
Crafts	32 47 10.29	79 58 07.14	213 00 51	North Base	33 01 32	3619.8	3958.5	2.25
			312 48 38	Styles	132 50 00	5419.2	5926.3	3.37

United States Coast Survey.—Geographical Positions. Section V.—Charleston Harbor. Sketch E.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Arsenal	32 47 07.61	79 56 41.62	295 16 22	Circular Church	115 16 56	1808.6	1977.8	1.12
			210 14 59	South Base	30 15 14	1382.4	1511.8	0.86
Fort Moultrie	32 45 31.14	79 51 14.90	79 37 33	Fort Johnson	259 36 17	3700.9	4047.2	2.30
			14 43 21	Vincent	194 43 03	3459.4	3783.0	2.15
Charleston Light	32 41 54.77	79 52 28.84	150 51 45	Circular Church	330 50 02	10149.6	11099.3	6.31
			159 57 30	Castle Pinckney	339 56 27	8825.3	9651.1	5.48
Beacon, (back of Sullivan's Island.)	32 46 50.54	79 51 15.87	8 23 22	Vincent	188 23 04	5854.7	6402.5	3.64
			80 33 25	Castle Pinckney	260 31 43	4990.7	5457.7	3.10
Beacon, (south of Fort Moultrie.)	32 45 29.40	79 51 10.95	80 41 58	Fort Johnson	260 40 40	3793.0	4147.9	2.36
			16 36 41	Vincent	196 36 21	3435.6	3757.1	2.13
Pinckney House, (on Sullivan's Island.)	32 45 47.52	79 49 59.19	36 30 47	Vincent	216 29 48	4790.1	5238.3	2.98
			243 43 03	Breach Inlet	63 43 44	2210.2	2417.0	1.37
Fort Sumpter	32 45 07.95	79 52 14.52	171 09 41	Mount Pleasant	351 09 28	3910.6	4276.5	2.43
			91 17 35	Fort Johnson	271 16 52	2089.5	2285.0	1.30
St. Michael's Church	32 46 33.11	79 55 37.60	308 51 17	Fort Johnson	128 52 23	4105.5	4489.7	2.55
			278 31 04	Castle Pinckney	98 31 43	1908.5	2807.1	1.19
Oyster Point	32 49 40.07	79 55 13.31	24 34 01	South Base	204 33 28	3850.4	4210.7	2.39
			6 54 17	Circular Church	186 54 03	5508.4	6023.8	3.42
White House	32 49 39.29	79 56 08.06	297 52 27	Hobcaw	117 53 30	3428.4	3749.2	2.13
			269 01 33	Oyster Point	89 02 03	1424.0	1557.2	0.89
Belvidere Mill	32 49 07.69	79 56 10.06	2 50 05	South Base	182 50 02	2507.8	2742.5	1.56
			349 40 51	Circular Church	169 41 08	4544.5	4969.7	2.82

United States Coast Survey.—Geographical Positions. Section V.—Charleston Harbor. Sketch E.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Wappoo	32 46 10.11	79 57 24.64	250 03 39	Circular Church	70 04 36	2931.0	3205.3	1.82
			212 17 11	Arsenal	32 17 34	2094.5	2290.5	1.30
Cotton Factory	32 47 45.03	79 55 52.45	317 42 01	Castle Pinckney	137 42 48	3377.8	3693.9	2.10
			196 01 43	Oyster Point	16 02 04	3687.3	4032.3	2.29
Flynn's Church	32 47 18.07	79 55 49.33	222 47 55	Hobcaw	42 48 48	3743.6	4093.9	2.33
			354 20 44	Styles	174 20 52	3942.3	4311.2	2.45
Hog Island Beacon	32 46 55.54	79 54 41.85	22 57 31	Styles	202 57 03	3506.8	2834.9	2.18
			335 51 04	Castle Pinckney	155 51 13	1067.1	1066.9	0.66
Grave Church	32 46 52.01	79 55 58.56	348 36 37	Styles	168 36 50	3183.0	3480.8	1.98
			218 06 03	Hobcaw	38 07 01	4510.8	4942.9	2.80
Orphans' Asylum	32 47 08.68	79 56 02.25	348 43 26	Styles	168 43 41	3705.5	4052.2	2.30
			268 25 36	Mount Pleasant	88 27 27	5326.6	5825.0	3.31
Gibbes' Observatory, Charleston.	32 47 05.33	79 55 59.81	148 17 40	Orphan Asylum	328 17 40	121.0	132.3	0.08
SAVANNAH, GA.								
Savannah Exchange Spire	32 04 53.36	81 05 14.32	....	....	....	....	....	....

United States Coast Survey.—Geographical Positions. Section VI.—Florida Keys. Sketch F.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
FLORIDA KEYS.	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Key West to Marquesas.								
Sand Key	24 27 09.51	0 00 00.00	....	....	....	....	....	....
West Crawfish Key	24 32 16.16	W. 0 00 22.71	356 07 21	Sand Key	176 07 30	9455.6	10340.4	5.88
Tift's Observatory..........	24 33 31.13	E. 0 04 12.27	31 10 55	Sand Key	211 09 11	13721.1	15005.0	8.53
			73 25 01	West Crawfish Key..........	253 23 07	8074.3	8829.8	5.02
East Crawfish Key	24 33 39.95	0 00 58.10	272 49 58	Tift's Observatory...........	92 51 18	5470.2	5982.1	3.40
			7 45 24	Sand Key	187 45 00	12150.7	13287.7	7.55
N. W. Boca Chica..........	24 38 24.62	0 05 53.51	17 30 37	Tift's Observatory...........	197 29 54	9467.9	10353.8	5.88
			43 30 40	East Crawfish Key	223 28 37	12072.7	13202.4	7.50
East Point	24 34 13.72	0 06 57.32	74 15 12	Tift's Observatory...........	254 14 04	4825.3	5276.8	3.00
			166 54 50	N. W. Boca Chica	346 54 23	7925.2	8666.8	4.92
Fleming's Key	24 34 40.07	0 04 45.57	195 27 25	N. W. Boca Chica...........	15 27 54	7168.0	7838.7	4.45
			23 50 10	Tift's Observatory...........	203 49 56	2318.7	2535.7	1.44
U. S. Barracks..............	24 33 37.93	0 05 04.77	250 49 12	East Point	70 49 59	3352.9	3666.6	2.08
			81 56 24	Tift's Observatory...........	261 56 03	1491.8	1631.4	0.93
Key West Light	24 32 58.10	0 04 35.87	81 17 13	West Crawfish Key	261 15 09	8500.6	9296.0	5.28
			239 41 01	East Point	59 42 00	4610.3	5041.7	2.86
Old Beacon................	24 32 38 01	E. 0 04 23.59	85 14 46	West Crawfish Key	265 12 47	8085.0	8841.5	5.03
			168 57 58	Tift's Observatory...........	348 57 53	1665.0	1820.8	1.04

United States Coast Survey.—Geographical Positions. Section VI.—Florida Keys. Sketch F.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Rocky Point	24 33 03.26	E. 0 07 19.22	99 16 01	Tift's Observatory	279 14 43	5329.9	5828.6	3.30
			166 18 02	N. W. Boca Chica	346 17 26	10176.5	11128.7	6.32
Western Sambo	24 28 47.10	0 09 34.60	133 56 34	Tift's Observatory	313 54 20	12596.2	13774.9	7.83
			79 31 13	Sand Key	259 27 15	16456.0	17995.8	10.22
Wreck of the Frankford	24 34 58.16	0 03 37.47	53 36 15	N. Crawfish Key	233 34 35	8397.1	9182.8	5.22
			211 03 21	N. W. Boca Chica	31 04 19	7415.2	8109.1	4.61
Bank in N. W. Channel	24 35 00 27	E. 0 03 05.52	216 54 54	N. W. Boca Chica	36 56 04	7864.6	8600.5	4.89
			49 15 30	W. Crawfish Key	229 14 04	7734.3	8458.0	4.81
Cotteral's Key	24 36 01.19	W. 0 02 38.04	331 10 55	W. Crawfish Key	151 11 51	7901.3	8640.6	4.91
			252 55 06	N. W. Boca Chica	72 58 39	15048.4	16456.5	9.35
Major Bache's Station on Cotteral's Key.	24 36 22.20	0 02 43.62	255 27 01	N. W. Boca Chica	75 30 36	15023.2	16428.9	9.33
			294 11 44	Tift's Observatory	114 14 37	12829.2	14029.6	7.97
Mullet Key	24 34 38.38	0 02 22.82	243 28 13	N. W. Boca Chica	63 31 40	15599.1	17058.7	9.69
			280 31 15	Tift's Observatory	100 33 59	11307.1	12365.1	7.02
A	24 33 22.84	0 00 25.22	358 16 56	W. Crawfish Key	178 16 56	2360.4	2581.3	1.47
			229 51 31	N. W. Boca Chica	49 54 08	13930.7	15234.2	8.66
B	24 32 39.30	0 02 07.74	261 29 50	Tift's Observatory	81 32 28	10811.4	11823.0	6.72
			340 28 37	Sand Key	160 29 30	10764.5	11771.7	6.69
C	24 32 36.67	0 02 22.87	261 24 30	Tift's Observatory	81 27 14	11244.5	12296.6	6.99
			280 33 40	W. Crawfish Key	100 34 30	3439.9	3761.8	2.14
Middle Ground	24 28 52.75	W. 0 00 17.31	221 31 28	Tift's Observatory	41 33 20	11442.0	12512.6	7.11
			178 36 37	W. Crawfish Key	358 36 35	6259.5	6845.2	3.89

United States Coast Survey.—Geographical Positions. Section VI.—Florida Keys. Sketch F.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Rock Key	24 27 18.30	E. 0 01 11.32	203 56 06	Tift's Observatory	23 57 21	12550.2	13724.5	7.80
			82 19 56	Sand Key	262 19 26	2026.8	2216.5	1.26
Eastern Dry Rocks	24 27 37.79	E. 0 02 03.10	75 55 09	Sand Key	255 54 18	3574.0	3908.4	2.22
			198 29 11	Tift's Observatory	18 30 05	11462.6	12535.2	7.12
Western Dry Rocks	24 26 43.70	W. 0 02 56.23	223 52 33	Tift's Observatory	43 55 31	17395.8	19023.5	10 80
			260 54 06	Sand Key	80 55 19	5026.2	5496.5	3.12
Woman Key	24 31 44.70	0 02 22.79	334 35 26	Sand Key	154 36 25	9372.2	10249.2	5.82
			326 15 43	Middle Ground	146 16 36	6360.7	6955.9	3.95
Woman Key, West	24 31 29.76	0 03 03.86	99 07 09	Boca Grande	279 05 10	8129.9	8890.6	5.05
			184 58 13	Cotteral's Key	4 58 24	8382.0	9166.3	5.21
Wreck of Brig Moreno (head.)	24 31 09.95	0 03 34.64	98 38 30	Man Key	278 37 48	2878.8	3148.2	1.79
			190 04 26	Cotteral's Key	10 04 49	9100.5	9952.0	5.65
Man Key	24 31 24.00	0 05 15.76	256 13 05	Tift's Observatory	76 17 00	16456.8	17996.7	10.23
			258 58 25	W. Crawfish Key	79 00 27	8402.1	9188.3	5.22
Lavina Bank	24 35 09.93	0 06 37.63	256 48 53	Cotteral's Key	76 50 33	6921.5	7569.1	4.30
			341 39 31	Man Key	161 40 05	7322.5	8007.7	4.55
Boca Grande	24 32 11.57	0 07 49.10	231 04 13	Cotteral's Key	51 06 23	11247.1	12299.5	6.99
			200 07 22	Lavina Bank	20 07 52	5844.1	6390.9	3.63
Boca Grande, East	24 31 45.82	0 07 15.79	130 12 27	Boca Grande	310 12 12	1227.2	1342.0	0.76
			189 42 11	Lavina Bank	9 42 27	6370.6	6966.7	3.96
Mule Key	24 34 46.20	W. 0 04 22.98	231 58 59	Cotteral's Key	51 59 43	3746.7	4097.3	2.33
			50 38 56	Boca Grande	230 37 30	7501.3	8203.2	4.66

United States Coast Survey.—Geographical Positions. Section VI.—Florida Keys. Sketch F.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Marquesas, Alpha	24 34 23.87	W. 0 13 21.99	293 28 04	Boca Grande	113 30 23	10213.4	11169.1	6.34
			262 52 40	Lavina Bank	82 55 28	11463.9	12536.6	7.12
Marquesas, Beta	24 32 54.59	0 14 20.45	210 54 50	Alpha	30 55 14	3201.8	3501.4	1.99
			252 14 31	Lavina Bank	72 17 44	13671.3	14950.5	8.49
Marquesas, Gamma	24 34 11.63	0 16 41.39	300 51 29	Beta	120 52 27	4619.8	5052.1	2.87
			266 08 49	Alpha	86 10 12	5622.7	6148.8	3.49
Marquesas, Delta	24 35 13.11	0 16 04.95	345 45 58	Epsilon	165 46 13	4179.0	4570.0	2.60
			288 16 32	Alpha	108 17 39	4828.2	5280.0	3.00
Marquesas, Epsilon	24 33 01.44	0 15 28.43	276 16 50	Beta	96 17 18	1924.4	2104.5	1.19
			136 27 17	Gamma	316 26 47	2979.5	3258.3	1.85
Marquesas, Theta	24 32 49.41	W. 0 16 53.69	261 13 32	Epsilon	81 14 08	2427.6	2654.8	1.51
			187 47 28	Gamma	7 47 33	2553.2	2792.1	1.59
CAPE FLORIDA AND KEY BISCAYNE BAY.								
Cape Florida Station	25 39 52.18	0 00 00.00	....	....	....	....	....	....
Cape Florida Light-house	25 39 55.85	W. 0 00 00.41	354 12 13	Cape Florida Station	174 12 13	113.6	124.2	0.07
Soldier Key	25 35 23.23	0 00 18.22	183 30 49	Cape Florida St.	3 30 57	8291.1	9066.9	5.15
Elliott's Beach	25 41 22.18	W. 0 05 36.66	286 24 58	Cape Florida St.	106 27 24	9786.8	10702.6	6.08
			321 10 35	Soldier Key	141 12 35	14172.5	15498.6	8.81
Key Biscayne	25 42 36.54	E. 0 00 13.73	4 19 42	Cape Florida St.	184 19 36	5071.9	5546.5	3.15
			76 50 11	Elliott's Beach	256 47 39	10032.2	10970.9	6.23

United States Coast Survey.—Geographical Positions. Section VI.—Key Biscayne Bay. Sketch F.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yards.	Miles.
Bear Cut	25 44 08.93	E. 0 00 39.98	8 02 01	Cape Florida St	188 01 45	7978.4	8724.9	4.96
			63 58 36	Elliott's Beach	243 55 54	11685.4	12778.8	7.26
Shoal Point	25 38 18.35	W. 0 06 52.97	255 54 10	Cape Florida St	75 57 09	11873.8	12984.8	7.38
			200 37 00	Elliott's Beach	20 37 33	6043.5	6609.6	3.76
Pearl Oyster Bank	25 38 39.55	0 01 56.67	235 30 25	Cape Florida St	55 31 16	3947.4	4316.8	2.45
			129 13 10	Elliott's Beach	309 11 35	7916.5	8657.3	4.92
West Point	25 42 36.61	0 01 15.60	72 32 51	Elliott's Beach	252 30 58	7629.5	8343.4	4.74
			8 55 29	Pearl Oyster Bank	188 55 11	7383.7	8074.6	4.59
Cormorant Point	25 44 14.10	0 03 30.28	33 40 01	Elliott's Beach	213 39 06	6385.7	6983.2	3.97
			308 37 24	West Point	128 38 23	4805.3	5254.9	2.99
Lewis' Point	25 45 26.00	0 02 02.02	38 34 54	Elliott's Beach	218 33 20	9595.8	10493.6	5.96
			346 03 36	West Point	166 03 56	5370.5	5873.0	3.34
Northwest Point	25 43 33.67	0 00 10.15	46 06 40	West Point	226 06 12	2531.7	2768.6	1.57
			....	Cormorant Point	....	5715.0	6249.8	3.55
Miami	25 46 15.64	0 01 55.49	350 37 45	West Point	170 38 06	6830.8	7470.0	4.24
			329 29 52	Northwest Point	149 30 38	5784.8	6326.1	3.60
Miami Channel Mark	25 45 00.01	0 01 46.70	348 52 57	West Point	168 53 11	4497.0	4917.8	2.79
			314 38 08	Northwest Point	134 38 50	3782.0	4135.9	2.35
Virginia Key	25 44 10.38	0 00 19.99	28 14 41	West Point	208 14 17	3275.5	3582.0	2.04
			346 21 31	Northwest Point	166 21 35	1163.2	1272.0	0.72
Southwest Point	25 41 06.00	W. 0 01 17.65	93 57 35	Elliott's Beach	273 55 43	7238.1	7915.4	4.50
			181 10 42	West Point	1 10 43	2788.6	3049.5	1.73

United States Coast Survey.—Geographical Positions. Section VI.—Key Biscayne Bay. Sketch F.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Beasley	25 43 18.94	W. 0 05 17.44	305 41 34	Cape Florida St	125 43 51	10899.5	11919.4	6.77
			278 01 30	Key Biscayne	98 03 54	9322.7	10195.0	5.79
Channel Barrel, (C. Florida)	25 40 20.73	0 01 40.05	106 00 25	Elliott's Beach	285 58 43	6862.7	7504.9	4.26
			189 15 29	West Point	9 15 40	4236.1	4632.5	2.63
Channel Stake, (C. Florida)	25 39 42.72	0 00 31.03	251 24 10	Cape Florida St	71 24 23	912.8	998.2	0.57
			109 46 18	Elliott's Beach	289 44 06	9054.6	9901.8	5.63
Middle Bank	25 37 40.89	0 00 19.28	187 34 55	Cape Florida St	7 35 03	4075.6	4457.0	2.53
			359 35 54	Soldier Key	179 35 53	4235.7	4632.0	2.63
James' Creek	25 39 37.11	0 06 34.66	206 34 25	Elliott's Beach	26 24 50	3614.8	3953.0	2.25
			267 33 49	Cape Florida St	87 36 40	11015.2	12045.9	6.84
Sands' Point	25 30 08.37	0 02 02.88	196 46 24	Soldier Key	16 47 09	10119.1	11066.0	6.29
			151 46 52	Shoal Point	331 44 47	17113.1	18714.3	10.63
Black Point	25 32 07.51	0 09 27.60	286 25 24	Sands' Point	106 28 36	12946.4	14157.8	8.04
			200 42 10	Shoal Point	20 43 17	12199.1	13340.6	7.58
Black Ledge	25 35 27.89	0 05 22.81	330 24 24	Sands' Point	150 25 50	11305.2	12363.0	7.02
			47 56 58	Black Point	227 55 13	9202.5	10063.6	5.72
Hunting Grounds	25 34 05.25	0 08 47.91	260 23 37	Soldier Key	80 27 17	14424.1	15773.9	8.96
			302 47 03	Sands' Point	122 49 58	13452.7	14711.5	8.36
Ragged Key, No. 1	25 32 30.69	0 00 49 68	189 23 15	Soldier Key	9 23 30	5380.6	5884.1	3.34
			87 12 21	Black Point	267 08 38	14475.4	15829.9	8.99
West Featherbed Bank	25 31 12.90	W. 0 06 04.53	231 26 00	Soldier Key	51 28 29	12360.7	13517.3	7.68
			286 22 44	Sands' Point	106 24 29	7034.5	7692.7	4.37

United States Coast Survey.—Geographical Positions. Section VI.—Key Biscayne Bay. Sketch F.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Turkey Point	25 26 17.13	W.0 09 39.79	240 49 57	Sands' Point	60 53 14	14678.7	16052.2	9.12
			181 47 42	Black Point	1 48 34	10786.4	11795.7	6.70
Pelican Bank	25 26 35.69	0 07 54.03	236 16 03	Sands' Point	56 18 34	11790.4	12893.6	7.33
			165 38 59	Black Point	345 38 19	10539.1	11525.3	6.55
Rubicon Point	25 23 45.24	0 05 28.32	205 56 55	Sands' Point	25 58 21	13111.1	14337.9	8.15
			123 38 30	Turkey Point	303 36 42	8438.8	9228.4	5.25
Elliott's Key, No. 1	25 29 04.25	0 01 14.43	187 39 45	Soldier Key	7 40 09	11766.3	12867.3	7.31
			112 17 47	Black Point	292 14 15	14879.9	16262.2	9.25
Elliott's Key, No. 3	25 25 34.84	0 03 21.96	194 42 12	Sands' Point	14 42 46	8701.2	9515.4	5.41
			97 02 57	Turkey Point	277 00 15	10636.0	11631.2	6.61
Coon Point	25 28 15.40	0 02 10.43	120 21 28	Black Point	300 18 20	14142.5	15465.8	8.79
			73 51 31	Turkey Point	253 48 18	13069.4	14292.3	8.12
Fender Point	25 30 06.96	0 10 22.97	202 37 22	Black Point	22 37 46	4018.8	4394.9	2.50
			350 19 05	Turkey Point	170 19 23	7173.8	7845.1	4.46
Convoy Point	25 27 46.62	W.0 10 37.80	193 43 13	Black Point	13 43 43	8263.3	9036.5	5.13
			329 31 02	Turkey Point	149 31 27	3195.2	3494.2	1.99

United States Coast Survey.—Geographical Positions. Section VIII.—Primary Stations. Sketch H.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Dauphin I'd Base { E. End	30 15 02.38	W. 0 06 51.09	....	....	....	....	....	....
Dauphin I'd Base { W. End	30 14 27.48	0 13 27.90	264 11 19.4	Base East	84 14 39.3	10661.7	11659.3	6.62
Cat Island	30 19 02.22	0 11 15.18	316 16 59.2	Base East	136 19 12.4	10214.3	11170.0	6.34
			22 45 22.7	Base West	202 44 15.7	9172.5	10030.8	5.70
Cedar Point	30 20 50.44	0 05 53.84	8 07 37.6	Base East	188 07 08.7	10825.6	11838.6	6.73
			45 50 50.8	Base West	225 47 02.2	16918.3	18501.3	10.51
Fort Morgan	30 13 48.23	0 00 00.00	93 15 32.1	Base West	273 08 45.3	21633.0	23657.2	13.44
			143 59 45.9	Cedar Point	323 56 47.5	16074.6	17578.7	9.99
Point aux Pines	30 22 09.79	0 17 28.39	335 41 27.7	Base West	155 43 29.1	15617.1	17078.4	9.70
			300 03 54.5	Cat Island	120 07 04.1	11519.0	12596.8	7.16
			277 27 19.8	Cedar Point	97 33 10.7	18705.6	20455.9	11.62
Petit Bois	30 12 15.28	0 22 23.26	254 05 26.4	Base West	74 09 55.8	14882.4	16275.0	9.25
			203 16 02.1	Point aux Pines	23 18 30.8	19928.6	21793.3	12.38
Grande Batture	30 19 31.78	0 23 50.78	299 19 45.8	Base West	119 25 09.9	19100.1	20887.3	11.87
			244 29 44.4	Point aux Pines	64 32 57.4	11311.2	12369.6	7.03
			350 07 22.3	Petit Bois	170 08 06.4	13641.5	14917.9	8.48
Horn Island East	30 13 21.15	0 30 33.50	278 45 40.9	Petit Bois	98 49 47.6	13264.4	14505.5	8.24
			223 17 41.4	Grande Batture	43 21 04.4	15685.6	17153.3	9.75
Bayou Casotte	30 19 50.49	0 29 24.41	273 40 42.8	Grande Batture	93 43 31.3	8929.5	9765.0	5.55
			321 12 20.8	Petit Bois	141 15 53.0	17975.5	19657.5	11.17
			8 45 34.0	Horn Island East	188 45 03.9	12129.3	13264.2	7.54
East Pascagoula	30 20 41.51	W. 0 31 22.28	354 30 19.8	Horn Island East	174 30 44.4	13621.7	14896.3	8.46
			296 30 48.6	Bayou Casotte	116 31 48.2	3518.1	3847.3	2.19

United States Coast Survey.—Geographical Positions. Section VIII.—Mobile Bay. Sketch H.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
MOBILE BAY.	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Sand Island Light..........	30 11 17.62	W. 0 01 33.16	208 14 14	Fort Morgan	28 15 01	5264.3	5756.9	3.27
			107 03 25	West Base	286 57 25	19986.8	21857.0	12.42
Pelican Island	30 13 15.52	0 64 26.38	308 04 04	Sand Island Light	128 05 31	5885.8	6436.6	3.66
			261 55 52	Fort Morgan	81 58 06	7193.6	7866.7	4.47
Mobile Point Light..........	30 13 45.64	0 00 03.44	228 27 15	Fort Morgan.................	48 27 17	123.2	134.7	0.08
			82 31 00	Pelican Island	262 28 47	7091.4	7754.9	4.41
Camp Dauphin	30 14 56.51	0 06 44.33	308 59 04	Sand Island Light...........	129 01 41	10708.4	11710.4	6.65
			280 58 40	Fort Morgan................	101 02 04	11012.0	12042.4	6.84
Dauphin Island East........	30 14 59.80	W. 0 03 04.54	294 03 21	Fort Morgan	114 04 54	5403.2	5908.8	3.36
			157 16 51	Cedar Point	337 15 23	11705.7	12801.0	7.27
Mobile Beach.	30 13 56.16	E. 0 03 45.85	60 14 37	Sand Island Light	240 11 57	9828.6	10748.3	6.11
			87 42 11	Fort Morgan	267 40 18	6043.2	6608.7	3.75
Navy Cove	30 14 45.81	0 03 38.09	73 06 19	Fort Morgan.	253 04 30	6093.5	6663.7	3.79
			92 19 20	Dauphin Island East.........	92 17 25	10771.1	11779.1	6.66
Mullet Point...............	30 24 45.53	E. 0 06 55.00	70 37 39	Cedar Point	250 31 11	21764.0	23800.4	13.52
			28 44 24	Fort Morgan.	208 40 55	23075.5	25234.7	14.34
Point Juliet.	30 22 58.20	W. 0 05 00.71	260 08 07	Mullet Point................	80 14 09	19386.6	21200.5	12.04
			334 35 55	Fort Morgan.	154 38 27	18742.9	20496.7	11.65
Fowl River Point...........	30 28 21.60	W. 0 04 24.74	290 05 57	Mullet Point................	110 11 42	19316.6	21124.1	12.00
			5 30 24	Point Juliet	185 30 06	10004.0	10940.1	6.22

United States Coast Survey.—Geographical Positions. Section VIII.—Mobile Bay. Sketch H.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Great Point Clear..........	30 29 04.57	E. 0 05 10.69	340 45 38	Mullet Point..................	160 46 31	8447.4	9237.8	5.25
			85 06 48	Fowl River Point	265 01 56	15403.3	16844.6	9.57
Dog River Point	30 35 46.90	W. 0 02 17.80	315 59 30	Great Point Clear	136 03 18	17214.9	18825.7	10.70
			13 52 15	Fowl River Point	193 51 11	14122.7	15444.2	8.77
Ragged Point...............	30 35 11.66	E. 0 06 28.43	94 27 47	Dog River Point	274 23 20	14059.9	15375.5	8.74
			10 23 35	Great Point Clear	190 22 55	11491.5	12566.8	7.09
Deer River Point	30 32 25.17	W. 0 03 29.21	293 58 59	Great Point Clear............	114 03 23	15174.3	16594.2	9.43
			252 06 48	Ragged Point.................	72 11 52	16729.9	18295.3	10.39
Alabama City...............	30 31 54.37	E. 0 06 56.95	70 13 00	Fowl River Point	250 07 52	19320.7	21128.5	12.00
			172 52 29	Ragged Point	352 52 15	6122.2	6695.1	3.80
Choctaw Point..............	30 40 11.21	W. 0 00 41.57	308 49 23	Ragged Point	128 53 02	14703.2	16079.0	9.13
			17 29 00	Dog River Point	197 28 11	8532.6	9331.0	5.30
Point Zeb	30 38 10.98	E. 0 06 14.67	356 11 58	Ragged Point	176 12 05	5533.5	6051.6	3.44
			108 30 09	Choctaw Point................	288 26 37	11683.6	12776.3	7.27
Garrow's Bend..............	30 39 07.04	W. 0 02 19.69	277 08 50	Point Zeb	97 13 12	13802.4	15093.9	8.58
			232 53 31	Choctaw Point	52 54 21	3275.2	3581.7	2.04
Choctaw Point Light	30 40 11.06	W. 0 00 42.53	308 44 48	Ragged Point.................	128 48 28	14720.1	16097.5	9.15
			288 22 55	Point Zeb	108 26 30	11706.0	12701.3	7.27
Apalacha River	30 39 52.84	E. 0 04 03.41	335 56 59	Ragged Point.................	155 58 14	9480.2	10367.3	5.89
			311 53 55	Point Zeb	131 55 02	4695.8	5135.2	2.92
Vessel Point...............	30 40 32.19	E. 0 06 07.73	357 33 58	Point Zeb	177 34 01	4352.1	4859.3	2.70
			56 54 22	Dog River Point	236 50 04	16073.2	17577.2	9.99

United States Coast Survey.—Geographical Positions. Section VIII.—Mobile Bay. Sketch H.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Crab Creek	30 43 03.18	E. 0 01 28.28	301 59 47	Vessel Point	122 02 10	8769.9	9590.6	5.45
			33 08 03	Choctaw Point	213 06 56	6323.1	6914.8	3.93
Blakely	30 44 16.17	0 05 32.03	70 53 55	Crab Creek	250 51 51	6862.5	7504.6	4.26
			352 09 23	Vessel Point	172 09 41	6962.2	7613.7	4.33
Tensaw River	30 41 35.62	E. 0 01 48.66	168 37 43	Crab Creek	348 37 33	2750.4	3007.8	1.71
			311 38 51	Point Zeb	131 41 07	9478.4	10365.3	5.89
Mobile, Episcopal Spire	30 41 26.25	W. 0 01 04.24	243 34 36	Blakely	63 37 58	11769.5	12870.8	7.31
			278 12 35	Vessel Point	98 16 15	11615.8	12702.7	7.22
Mobile, Barton Academy	30 41 23.75	0 01 28.13	312 02 48	Ragged Point	132 06 51	17096.3	18696.0	10.62
			277 25 31	Vessel Point	97 29 24	12235.2	13380.1	7.60
Opposite Mobile Island	30 42 02.69	W. 0 00 41.99	281 44 13	Tensaw River	101 45 29	4094.6	4477.7	2.54
			359 48 53	Choctaw Point	179 48 53	3432.8	3754.0	2.13
Minetta Bay	30 42 29.09	E. 0 05 26.37	343 00 01	Vessel Point	163 00 22	3764.2	4116.4	2.34
			99 25 43	Crab Creek	279 23 41	6420.5	7021.3	3.99
Middle Apalacha	30 42 51.01	0 04 54.91	61 14 00	Choctaw Point	241 11 08	10217.0	11173.0	6.35
			93 54 52	Crab Creek	273 53 06	5509.9	6025.5	3.42
Middle Tensaw	30 43 12.78	0 02 42.33	44 09 09	Choctaw Point	224 07 25	7791.1	8520.1	4.84
			246 36 06	Blakely	66 37 33	4918.2	5378.4	3.06
Spanish River	30 43 32.37	0 00 21.45	296 48 57	Crab Creek	116 49 31	1992.2	2178.6	1.24
			15 09 07	Choctaw Point	195 08 35	6417.3	7017.8	3.99
Upper Tensaw	30 44 47.11	E. 0 03 50.32	40 25 55	Choctaw Point	220 23 36	11158.3	12202.4	6.93
			289 23 04	Blakely	109 23 56	2868.0	3136.4	1.78

United States Coast Survey.—Geographical Positions. Section VIII.—Bonsecours Bay. Sketch H.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
St. Louis Point	30 44 04.70	W. 0 01 21.75	202 57 38	Mobile River	22 58 12	4556.3	4982.6	2.83
			292 42 56	Crab Creek	112 44 23	4903.6	5362.4	3.05
Opposite Chickasaw Bayou	30 44 26.93	0 00 57.37	303 38 18	Crab Creek	123 39 32	4654.1	5089.6	2.89
			356 56 36	Choctaw Point	176 56 44	7885.5	8623.4	4.90
Mobile River	30 46 20.94	W. 0 00 14.90	335 44 03	Crab Creek	155 44 56	6679.2	7304.2	4.15
			3 34 05	Choctaw Point	183 33 51	11407.0	12474.4	7.09
BONSECOURS BAY.								
Little Point Clear, No. 1	30 15 50.84	E. 0 05 18.10	188 55 34	Mullet Point	8 56 23	16665.5	18224.9	10.35
			128 34 00	Point Juliet	308 28 48	21127.2	23104.1	13.13
Cypress Point	30 20 03.45	0 12 48.17	132 40 28	Mullet Point	312 37 30	12819.6	14019.1	7.96
			57 08 09	Little Point Clear, No. 1	237 04 22	14321.1	15661.1	8.90
Fish River	30 22 59.00	0 09 44.12	317 42 26	Cypress Point	137 43 59	7305.4	7989.0	4.54
			347 33 34	Shell Bank Bayou	167 34 34	14669.8	16042.5	9.11
Shell Bank Bayou	30 15 13.75	0 11 42.35	96 22 18	Little Point Clear, No. 1	276 19 05	10333.7	11300.6	6.42
			191 08 58	Cypress Point	11 09 31	9091.7	9942.4	5.65
Oyster Cove	30 14 25.80	0 08 51.85	252 02 17	Shell Bank Bayou	72 03 43	4790.8	5239.1	2.98
			114 38 11	Little Point Clear, No. 1	294 36 23	6285.1	6873.2	3.91
Bonsecours Bay	30 17 50.79	0 15 41.20	52 52 19	Shell Bank Bayou	232 50 19	8007.8	8757.1	4.98
			131 28 46	Cypress Point	311 27 19	6168.3	6745.5	3.83
New Bonsecours Harbor	30 17 51.97	E. 0 15 41.00	131 23 44	Cypress Point	311 22 16	6153.2	6729.0	3.82
			52 45 11	Shell Bank Bayou	232 43 10	8013.7	8763.6	4.98

United States Coast Survey.—Geographical Positions. Section VIII.—Mississippi Sound. Sketch H.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
West Gulf Shore	30 13 54.57	E. 0 13 06.10	209 30 56	New Bonsecours Harbor	29 32 14	8400.5	9186.5	5.22
			137 40 08	Shell Bank Bayou	317 39 26	3324.4	3635 5	2.06
East Gulf Shore	30 14 15.29	E. 0 18 22.77	85 42 50	West Gulf Shore	265 40 11	8490.3	9284.7	5.28
			147 03 59	New Bonsecours Harbor	327 02 37	7950.2	8694.1	4.94
MISSISSIPPI SOUND.								
Grant's Pass Light-house	30 17 37.22	W. 0 07 04.16	355 48 36	East Base	175 48 43	4780.6	5227.9	2.97
			60 21 32	West Base	240 18 19	11803.2	12907.6	7.33
Grant's Pass	30 17 41.56	0 06 39.53	3 36 32	East Base	183 36 22	4911.2	5370.7	3.05
			61 19 35	West Base	241 16 09	12443.2	13607.5	7.73
Little Dauphin Island	30 16 53.74	0 05 40.80	28 43 49	East Base	208 43 13	3910.0	4275.9	2.43
			113 54 09	Cat Island	293 51 39	9771.4	10685 7	6.07
John's House	30 18 44.55	0 06 40.49	2 21 44	East Base	182 21 39	6847.2	7487.9	4.25
			54 00 22	West Base	233 56 57	13461.4	14721.0	8.36
Marsh Island	30 19 24.09	0 14 00.18	354 36 08	West Base	174 36 24	9173.3	10031 7	5.70
			278 40 28	Cat Island	98 41 51	4458.6	4875 8	2.77
Bayou Coq d'Inde	30 22 22.48	0 12 38.94	340 03 24	Cat Island	160 04 07	6559.6	7173.4	4.08
			21 33 16	Marsh Island	201 32 35	5905.8	6458.4	3.67
Murder Point	30 20 23,96	0 10 30.51	25 21 31	Cat Island	205 21 08	2785.7	3046 4	1.73
			136 46 53	Bayou Coq d'Inde	316 46 12	5007.5	5476.1	3.11
Pass Barron	30 19 20.25	W. 0 09 25.69	332 29 45	East Base	152 31 09	8950.5	9788.0	5.56
			79 15 32	Cat Island	259 14 37	2976.1	3254.6	1.85

United States Coast Survey.—Geographical Positions. Section VIII.—Mississippi Sound. Sketch H.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	Metres.	Yard.	Miles.
Petit Bois East	30 14 01.23	W. 0 15 48.20	128 18 53	Grande Batture	308 14 50	16428.6	17965 8	10.21
			72 52 03	Petit Bois	252 48 44	11056.5	12091 1	6.87
Petit Bois West	30 12 16.44	0 25 50.34	193 23 59	Grande Batture	13 24 59	13779.7	15069 1	8.56
			104 45 42	Horn Island East	284 43 19	7829.8	8562 4	4.86
Bayou Lafourche	30 23 18.32	0 20 31.99	37 17 03	Grande Batture	217 15 23	8765.5	9585.6	5.45
			293 16 36	Point aux Pines	113 18 09	5336.5	5835.8	3.32
Grande Batture East	30 20 59.49	0 22 01.81	47 08 52	Grande Batture	227 07 57	3970.5	4342 0	2.47
			253 27 59	Point aux Pines	53 29 48	7614.9	8327 4	4.73
West Grand Bay	30 22 00.83	0 23 20.52	9 59 21	Grande Batture	189 59 06	4660.0	5096 0	2.90
			313 35 06	Grande Batture East	133 35 46	2819.4	3083 2	1.75
East Grand Bay	30 24 13.38	0 19 07.87	325 05 01	Point aux Pines	145 05 52	4640.5	5074 7	2.88
			37 53 11	Grande Batture East	217 51 52	7563.5	8271 2	4.70
Point aux Chenes	30 19 05.11	0 27 36.88	24 02 08	Horn Island East	204 00 39	11595.0	12680 0	7.20
			326 23 06	Petit Bois	146 25 44	15148.9	16566 4	9.41
Ship Yard	30 20 45.19	0 32 14.93	290 17 01	Bayou Casotte	110 18 28	4855 4	5309 7	3.02
			348 46 49	Horn Island East	168 47 40	13938.5	15242 7	8.68
Round Island	30 18 04.15	0 34 01.08	209 45 12	Ship Yard	29 46 05	5712.1	6240 6	3.55
			246 05 02	Bayou Casotte	66 07 22	8083.5	8839 9	5.02
Round Island Light	30 17 30.51	0 33 44.64	256 42 53	Grande Batture	76 47 53	16297.6	17823 6	10.13
			326 20 44	Horn Island East	146 22 20	9222.4	10083 3	5.73
Horn Island, (1)	30 13 46.73	W. 0 34 45.52	203 01 16	East Pascagoula	23 03 00	13878.1	15176 7	8.62
			276 39 01	Horn Island East	96 41 08	6784.2	7419 0	4.22

United States Coast Survey.—Geographical Positions. Section VIII.—Mississippi Sound. Sketch H.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Horn Island, (2)	30 14 14.52	W. 0 37 32.05	231 31 11	Bayou Casotte	51 35 17	16637.6	18194.4	10.34
			278 19 32	Horn Island East	98 23 02	11310.6	12368.9	7.03
Horn Island West	30 15 18.86	0 41 45.94	247 03 41	Bayou Casotte	67 09 55	21506.2	23518.5	13.36
			281 21 07	Horn Island East	101 26 46	18338.8	20054.8	11.39
Bayou Gravellines	30 21 44.19	0 36 47.69	326 41 29	Round Island	146 42 53	8106.1	8864.6	5.04
			286 26 39	Bayou Casotte	106 30 22	12344.5	13499.6	7.67
Bellefontaine	30 20 38.21	0 41 11.48	274 23 57	Bayou Casotte	94 29 54	18941.0	20713.0	11.77
			308 14 33	Horn Island East	128 19 54	21719.0	23751.2	13.49
Ship Island East	30 14 47.53	0 50 10.14	265 52 12	Horn Island West	85 56 26	13512.2	14776.3	8.39
			233 05 02	Bellefontaine	53 09 34	17992.7	19676.6	11.18
Deer Island	30 21 36.78	0 47 41.13	320 46 44	Horn Island West	140 49 43	15014.6	16419.6	9.33
			17 32 39	Ship Island East	197 31 24	13214.9	14451.4	8.21
Ship Island Main	30 14 34.80	0 51 56.21	207 39 37	Deer Island	27 41 46	14671.9	16044.7	9.12
			262 07 12	Ship Island East	82 08 05	2862.5	3130.4	1.78
Chandeleur Light	30 03 21.57	W. 0 51 24.26	214 21 29	Horn Island West	34 26 19	27389.4	29952.2	17.02
			177 42 13	Ship Island Main	357 41 57	21265.7	23255.5	13.21
Biloxi Bay.								
Monk's Point	30 21 02.09	W. 0 43 37.70	48 11 51	Ship Island Main	228 07 39	17877.8	19550.8	11.11
			99 20 57	Deer Island	279 18 54	6587.4	7203.2	4.09
Marsh Point	30 23 06.89	W. 0 46 52.28	25 10 44	Deer Island	205 10 19	3065.6	3352.9	1.90
			306 28 28	Monk's Point	126 30 06	6461.9	7066.6	4.02

United States Coast Survey.—Geographical Positions. Section VIII.—Mississippi Sound. Sketch H.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Miles.*	*Yards.*
Deer Island East	30 21 31.08	W. 0 47 13.09	278 48 25	Monk's Point	98 50 14	5820.5	6365.1	3.62
			190 39 51	Marsh Point	10 40 02	3001.8	3282.9	1.86
Point Cadde	30 24 23.78	0 50 09.46	294 12 28	Marsh Point	114 14 08	5771.1	6311.0	3.59
			318 27 57	Deer Island East	138 29 26	7102.4	7766.5	4.41
Plummer	30 24 52.04	0 49 06.18	333 59 05	Deer Island East	154 00 02	6884.7	7529.2	4.28
			62 45 04	Point Cadde	242 44 32	1899.7	2077.8	1.18
Point Joli	30 25 24.55	0 51 15.81	316 34 30	Point Cadde	136 35 04	2376.1	2598.3	1.48
			286 07 59	Plummer	106 09 04	3601.2	3937.9	2.24
Rhodes' Ship Yard	30 24 48.60	0 51 17.29	268 15 37	Plummer	88 16 44	3500.5	3828.1	2.18
			182 02 25	Point Joli	2 03 26	1107.6	1211.7	0.69
Point Blanc	30 25 21.45	0 53 23.03	268 22 47	Point Joli	88 23 51	3395.9	3713.8	2.11
			286 45 58	Rhodes' Ship Yard	106 47 01	3504.4	3831.9	2.18
Point Pierre	30 25 50.04	0 53 20.72	299 51 45	Rhodes' Ship Yard	119 52 49	3798.4	4153.4	2.36
			3 59 26	Point Blanc	183 59 25	882.5	965.6	0.55
Harvey	30 25 06.01	0 55 16.41	261 03 35	Point Blanc	81 04 32	3062.8	3349.6	1.90
			246 16 42	Point Pierre	66 17 41	3371.7	3687.5	2.09
Marsh Island	30 25 25.35	0 55 23.40	272 08 00	Point Blanc	92 09 01	3214.3	3514.7	2.00
			342 36 54	Harvey	162 36 58	624.2	682.4	0.39
Hawley	30 25 33.58	0 57 06.36	286 07 57	Harvey	106 08 53	3054.4	3339.8	1.90
			275 15 45	Marsh Island	95 16 37	2759.1	3017.2	1.71
Fowler	30 24 59.32	W. 0 56 52.99	251 27 28	Marsh Island	71 28 13	2521.4	2756.9	1.57
			161 18 24	Hawley	341 18 17	1113.7	1218.2	0.69

United States Coast Survey.—Geographical Positions. Section VIII.—Mississippi Sound. Sketch II.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Bernard's Bayou	30 25 02.10	W.0 58 45.38	249 50 45	Hawley	69 51 35	2814.5	3077 3	1.75
			271 37 34	Fowler	91 38 31	3000.6	3281 8	1.86
Chatakabafa Saw Mill	30 26 11.80	W.0 58 03.95	319 40 51	Fowler	139 41 27	2926.7	3200 9	1.82
			27 15 31	Bernard's Bayou	207 15 10	2414.1	2639 9	1.50
Mississippi Sound.								
Biloxi Pier	30 22 58.89	W.0 52 29.88	288 08 16	Deer Island	108 10 42	8113.1	8872 3	5.04
			356 40 54	Ship Island Main	176 41 11	15547.4	17002 2	9.66
*Biloxi Light	30 23 46.2	0 52 44.9	....	Biloxi Pier	....	1477.5	1615 8	0.92
Mississippi City	30 22 54.21	1 00 33.95	317 59 39	Ship Island Main	138 04 00	20682.1	22617 3	12.85
			269 19 34	Biloxi Pier	89 23 39	12923.2	14132 4	8.03
Cat Island Main	30 14 22.02	1 02 41.36	268 38 54	Ship Island Main	88 44 19	17251.6	18865 8	10.72
			192 10 15	Mississippi City	12 11 19	16133.6	17643 2	10.02
Montgomery	30 23 36.05	0 56 29.99	78 49 33	Mississippi City	258 47 30	6638.3	7259 1	4.12
			20 12 21	Cat Island Main	210 09 14	19733.3	21579 4	12.26
Ship Island West	30 12 54.46	0 56 36.19	247 33 14	Ship Island Main	67 35 35	8098.2	8856 0	5.03
			105 27 44	Cat Island Main	285 24 40	10129.1	11076 9	6.29
Ship Island, (2)	30 13 16.51	0 52 52.04	211 49 19	Ship Island Main	31 49 47	2837.0	3102 5	1.72
			83 31 14	Ship Island West	263 31 21	6026.8	6590 7	3.74
Pitcher Point, (1)	30 20 02.21	W.1 09 31.44	249 42 28	Mississippi City	69 46 59	15297.9	16729 3	9.51
			313 40 47	Cat Island Main	133 44 14	15159.4	16577.9	9.42

United States Coast Survey.—Geographical Positions. Section VIII.—Mississippi Sound. Sketch H.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yard.*	*Miles.*
Pitcher Point, (2)	30 20 02.70	W. 1 09 31.35	249 45 27	Mississippi City	69 49 59	15290.6	16721.2	9.50
			313 43 37	Cat Island Main	133 47 03	15167.4	16586.2	9.42
Point Blanc	30 21 27.62	1 05 31.08	340 54 03	Cat Island Main	160 55 29	13866.8	15164.5	8.61
			67 50 40	Pitcher Point, (2)	247 48 39	6928.8	7577.3	4.30
Cat Island Light	30 13 56.69	1 08 17.98	265 01 18	Cat Island Main	85 04 08	9033.1	9878.2	5.61
			170 08 09	Pitcher Point, (2)	350 07 32	11439.0	12509.4	7.11
Cat Island, (3)	30 12 53.60	1 03 18.27	269 49 52	Ship Island West	89 52 15	10751.8	11757.9	6.68
			199 55 16	Cat Island Main	19 55 35	2895.8	3166.8	1.80
Cat Island, (2)	30 12 41.05	1 03 26.70	267 49 03	Ship Island West	87 52 30	10984.9	12012.8	6.83
			210 28 09	Cat Island (3)	30 29 13	434.6	475.3	0.27
Cat Island, South Spit	30 11 22.78	1 04 38.96	257 42 02	Ship Island West	77 42 05	13216.1	14452.7	8.21
			218 47 17	Cat Island (2)	38 43 53	3089.1	3378.2	1.93
Cat Island, Middle Spit	30 12 50.09	1 05 34.28	115 03 44	Cat Island Light	295 03 26	4832.7	5284.9	3.00
			274 16 46	Cat Island (2)	94 17 50	3422.3	3742.5	2.13
South Shell Bank	30 10 57.45	1 11 43.59	224 53 13	Cat Island Light	44 54 57	7789.3	8518.2	4.84
			250 37 08	Middle Spit	70 40 13	10469.1	11448.7	6.50
Isle au Pied	30 10 14.16	1 07 46.59	236 54 45	Cat Island (2)	56 56 07	8294.5	9070.6	5.15
			173 00 45	Cat Island Light	353 00 29	6901.4	7547.3	4.29
Pass Christian Light	30 18 54.35	1 13 37.35	316 58 13	Cat Island Light	137 03 28	12520.7	13692.3	7.78
			295 28 03	Cat Island Main	115 35 34	19430.1	21248.2	12.07
Pass Christian	30 18 30.22	W. 1 14 43.83	251 08 32	Pitcher Point, (2)	71 11 10	8819.1	9644.2	5.48
			309 12 48	Cat Island Light-house	129 16 03	13314.4	14559.8	8.27

United States Coast Survey.—Geographical Positions. Section VIII.—Mississippi Sound. Sketch H.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Merritt's Coquille..........	30 13 45.71	W.1 15 28.01	219 21 52	Pitcher Point, (2)...........	39 24 52	15019.1	16424.4	9.33
			268 17 14	Cat Island Light-house.......	88 20 49	11502.5	12578.8	7.15
St. Louis Bay.								
Henderson's Point..........	30 18 24.73	W.1 16 12.83	303 00 12	Cat Island Light............	123 04 11	15138.5	16555.0	9.41
			352 03 32	Merritt's Coquille...........	172 03 55	8674.1	9485.6	5.39
Shieldsboro'...............	30 17 57.34	1 18 50.70	325 01 27	Merritt's Coquille...........	145 03 09	9453.6	10338.6	5.87
			258 40 50	Henderson's Point..........	78 42 10	4301.1	4703.4	2.67
Delectable Point...........	30 19 37.47	1 16 09.72	2 07 37	Henderson's Point..........	182 07 35	2241.3	2450.7	1.39
			54 22 20	Shieldsboro'................	234 20 59	5291.4	5786.1	3.29
Coward's Point............	30 20 19.36	1 18 34.09	313 04 42	Henderson's Point..........	133 05 53	5166.4	5649.9	3.21
			288 28 54	Delectable Point............	108 30 07	4065.8	4446.5	2.53
Cedar Hammock...........	30 22 05.96	1 16 35.99	351 16 26	Delectable Point............	171 16 39	4625.7	5058.8	2.87
			43 51 31	Coward's Point.............	223 50 31	4551.9	4977.9	2.83
St. Louis Bay..............	30 21 55.04	W.1 20 03.18	321 04 18	Coward's Point.............	141 05 03	3787.0	4141.3	2.35
			266 30 22	Cedar Hammock............	86 32 07	5542.1	6060.6	3.44

United States Coast Survey.—Geographical Positions. Section IX.—Galveston Bay. Sketch I.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
GALVESTON BAY.	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Dollar Point	29 26 02.61	W. 6 52 15.00	....	....	....	....	....	....
Bolivar Point	29 22 35.10	6 45 15.02	119 27 49	Dollar Point	299 24 23	12999.5	14215.9	8.08
Parr's Grove	29 25 50.06	6 40 09.14	91 10 51	Dollar Point	271 04 54	19565.8	21396.6	12.16
			53 58 13	Bolivar Point	233 55 43	10199.0	11153.3	6.34
Smith's Point	29 31 34.15	6 44 56.82	49 10 40	Dollar Point	229 07 05	15604.6	17064.7	9.70
			1 41 38	Bolivar Point	181 41 29	16602.6	18156.1	10.32
Long Grove	29 31 58.14	6 42 25.79	341 59 43	Parr's Grove	162 00 50	11914.8	13029.7	7.40
			79 42 56	Smith's Point	259 41 42	4133.0	4516.8	2.57
Fredenberg	29 24 48.28	6 43 07.53	248 24 19	Parr's Grove	68 25 47	5170.8	5654.6	3.21
			39 58 53	Bolivar Point	219 57 50	5350.1	5850.7	3.32
Widow Yates	29 23 26.98	6 43 52.33	173 23 46	Smith's Point	353 23 14	15098.6	16511.4	9.38
			233 46 26	Parr's Grove	53 48 16	7456.5	8154.2	4.63
Bunker	29 21 59.99	6 44 25.31	128 53 33	Bolivar Point	308 53 09	1722.2	1883.4	1.07
			224 15 25	Parr's Grove	44 17 31	9892.8	10818.5	6.15
Galveston Court House	29 18 14.47	6 46 08.82	184 30 07	Smith's Point	4 30 43	24695.8	27006.6	15.34
			214 38 26	Parr's Grove	34 41 22	17053.2	18648.9	10.59
Galveston Cathedral	29 18 17.35	6 46 14.17	145 50 05	Dollar Point	325 47 08	17315.7	18935.9	11.76
			191 21 54	Bolivar Point	11 22 23	8093.7	8851.0	5.03
Galveston Episcopal Church	29 18 11.83	W. 6 46 21.29	158 15 39	Smith's Point	5 16 21	24805.4	27126.4	15.41
			215 24 10	Parr's Grove	35 27 12	17312.9	18932.9	10.76

United States Coast Survey.—Geographical Positions. Section IX.—Galveston Bay. Sketch I.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Fort Point	29 20 04.49	W. 6 44 38.64	131 53 32	Dollar Point	311 49 48	16521.3	18067.2	10.26
			168 03 20	Bolivar Point	348 03 02	4739.4	5182.9	2.94
Galveston Beach	29 18 32.19	6 44 49.11	78 45 41	Cathedral	258 44 59	2340.0	2559.0	1.45
			174 39 50	Bolivar Point	354 39 37	7511.0	8213.8	4.67
West Bay Point	29 18 01.38	6 49 08.45	161 15 25	Dollar Point	341 13 53	15646.3	17109.3	9.72
			216 45 01	Bolivar Point	36 46 56	10519.6	11503.9	6.54
Virginia Point	29 19 12.62	6 52 12.44	179 41 12	Dollar Point	359 41 11	12622.5	13803.6	7.84
			240 59 55	Bolivar Point	61 03 19	12869.3	14073.6	8.00
Pelican Island	29 21 17.88	6 48 07.14	242 52 01	Bolivar Point	62 53 26	5215.0	5703.0	3.24
			331 15 11	Cathedral	51 16 06	6338.2	6931.3	3.94
Wilcox	29 22 46.63	6 52 24.60	182 27 21	Dollar Point	2 27 26	6039.2	6604.3	3.75
			271 43 31	Bolivar Point	91 47 01	11588.7	12673.1	7.20
Shoal Point	29 23 43.24	6 52 12.20	178 59 33	Dollar Point	358 59 33	4291.4	4692.9	2.67
			280 32 07	Bolivar Point	100 35 32	11442.0	12512.6	7.11
Hanna's Reef	29 28 06.29	6 48 30.29	287 13 03	Parr's Grove	107 17 10	14139.7	15462.8	8.79
			57 50 54	Dollar Point	237 49 03	7152.6	7821.9	4.44
Edward's Point	29 29 49.07	6 53 23.29	315 24 13	Bolivar Point	135 28 13	18752.0	20506.6	11.66
			345 12 49	Dollar Point	165 13 22	7210.7	7885.4	4.48
Heron Grove	29 25 15.81	6 55 31.46	202 18 28	Edward's Point	22 19 31	9094.1	9945.0	5.65
			254 45 46	Dollar Point	74 47 22	5487.3	6000.8	3.41
Miller's Point	29 26 57.91	W. 6 53 55.07	189 13 36	Edward's Point	9 13 52	5338.8	5838.4	3.32
			302 15 22	Dollar Point	122 16 11	3189.0	3487.4	1.98

United States Coast Survey.—Geographical Positions. Section IX.—Galveston Bay. Sketch I.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Cedar Point	29 40 09.07	W. 6 51 24.43	326 38 02	Smith's Point	146 41 13	18975.7	20751.3	11.79
			9 31 14	Edward's Point	189 30 15	19354.0	21161.0	12.02
Vingtune Island	29 33 39.04	6 45 39.72	343 16 42	Smith's Point	163 17 03	4014.6	4390.3	2.49
			60 28 03	Edward's Point	240 24 15	14349.4	15692.1	8.91
Middle Pass	29 30 51.52	6 51 09.06	178 37 16	Cedar Point	358 37 09	17170.4	18777.0	10.67
			262 30 50	Smith's Point	82 33 54	10108.8	11054.7	6.28
Opossum Pass	29 31 14.60	6 48 28.07	163 55 30	Cedar Point	343 54 03	17125.3	18727.7	10.64
			263 56 43	Smith's Point	83 58 27	5719.7	6254.9	3.55
Rock Spring	29 30 34.01	6 56 47.52	206 07 53	Cedar Point	26 10 32	19723.7	21569.3	12.25
			284 06 20	Edward's Point	104 08 01	5671.5	6202.2	3.54
Morris	29 34 07.16	6 59 30.83	229 33 01	Cedar Point	49 37 01	17185.8	18793.9	10.68
			308 44 16	Edward's Point	128 47 17	12690.7	13878.2	7.89
Red Bluff West	29 35 03.04	6 58 48.88	231 43 39	Cedar Point	51 47 19	15221.4	16645.7	9.46
			317 46 32	Edward's Point	137 49 12	13048.6	14269.6	8.11
Red Bluff	29 36 12.39	6 57 44 48	234 29 24	Cedar Point	54 32 32	12553.2	13727.8	7.80
			329 11 45	Edward's Point	149 13 54	13736.9	15022.2	8.54
Flander's Grove	29 32 16.39	6 59 34.76	202 12 42	Red Bluff	22 13 36	7848.4	8583.0	4.88
			193 31 42	Red Bluff West	13 32 00	5277.1	5770.9	3.28
Houston	29 39 20.63	6 53 26.12	359 45 04	Edward's Point	179 45 06	17596.7	19243.2	10.93
			50 11 28	Red Bluff	230 09 20	9048.7	9895.4	5.62
Morgan Point	29 40 55.99	W. 6 57 55.41	277 47 52	Cedar Point	97 51 06	10610.4	11603.2	6.59
			358 04 17	Red Bluff	178 04 23	8736.3	9553.8	5.43

United States Coast Survey.—Geographical Positions. Section IX.—Galveston Bay. Sketch I.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Mezquit Knoll	29 39 37.02	W. 6 54 31.30	39 31 42	Red Bluff	219 30 06	8166.4	8930.5	5.07
			113 54 30	Morgan Point	293 52 49	6002.4	6564.1	3.73
Salt Works...............	29 40 06.21	6 54 23 02	36 58 54	Red Bluff	216 57 14	9010.2	9853.3	5.60
			105 02 12	Morgan Point	285 00 27	5912.1	6465.3	3.67
Pottery	29 40 36.08	6 54 38.02	31 43 10	Red Bluff	211 41 28	9542.6	10435.5	5.93
			96 36 00	Morgan Point	276 34 22	5342.0	5841.9	3.32
Clopper	29 40 53.69	6 57 01.38	300 19 00	Mezquit Knoll	120 20 14	4674.9	5112.4	2.91
			92 47 23	Morgan Point..............	272 46 57	1454.4	1590.5	0.90
Hackberry Point..........	29 37 23.20	6 59 06.90	207 30 19	Clopper	27 31 21	7306.9	7990.6	4.54
			240 54 50	Mezquit	60 57 07	8480.3	9273.8	5.27
Dr. Harris	29 37 58.82	6 59 39.66	218 19 05	Clopper	38 20 23	6862.9	7505.1	4.26
			249 56 57	Mezquit	69 59 30	8826.6	9652.5	5.48
Dr. Beasley	29 39 34.42	W. 6 59 04.87	233 40 29	Clopper	53 41 30	4120.7	4506.3	2.56
			269 21 30	Mezquit	89 23 45	7356.7	8045.1	4.57
San Jacinto River.								
Allen	29 41 11.18	W. 6 54 58.40	345 53 16	Mezquit	165 53 29	2989.1	3268.8	1.86
			84 23 57	Morgan Point..............	264 22 29	4781.5	5228.9	2.97
Dalton Point	29 42 33.73	6 58 39.93	293 05 53	Allen	113 07 43	6474.4	7080.2	4.02
			338 18 33	Morgan Point..............	158 18 55	3238.5	3541.5	2.01
Spilman Island	29 42 03.12	W. 6 59 11.60	222 05 11	Dalton Point	42 05 27	1269.9	1388.7	0.79
			315 15 16	Morgan Point..............	135 15 54	2909.7	3182.0	1.81

United States Coast Survey.—Geographical Positions. Section IX.—Galveston Bay. Sketch I.

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Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Brinson Point	29 42 17.66	W. 7 00 47.87	261 48 17	Dalton Point	81 49 21	3473.9	3799.0	2.16
			298 27 52	Morgan Point	118 29 18	5273.8	5767.3	3.28
Dalton's House	29 42 59.99	6 58 38.51	2 42 47	Dalton Point	182 42 46	809.6	885.4	0.50
			69 27 31	Brinson Point	249 26 27	3713.0	4060.4	2.31
Ship Yard	29 42 47.80	6 59 58.75	54 53 56	Brinson Point	234 53 32	1613.6	1764.6	1.00
			281 33 15	Dalton Point	101 33 54	2162.2	2364.5	1.34
Scott	29 44 12.29	7 00 27.59	325 54 04	Morgan Point	145 55 19	7297.6	7980.4	4.53
			8 46 40	Brinson Point	188 46 30	3571.0	3905.1	2.21
Brown's Island	29 44 05.87	7 02 02.83	265 34 52	Scott	85 35 40	2566.5	2806.7	1.59
			328 50 13	Brinson Point	148 50 50	3893.3	4257.6	2.42
Routh	29 42 18.58	7 01 12.96	157 55 18	Brown's Island	337 54 53	3564.7	3898.3	2.22
			199 11 56	Scott	19 12 19	3706.9	4053.8	2.30
Drasdo	29 44 48.74	7 01 59.99	294 19 25	Scott	114 20 11	2724.5	2979.4	1.69
			3 18 19	Brown's Island	183 18 17	1322.1	1445.8	0.82
Pine	29 45 04.49	7 02 48.90	290 15 00	Drasdo	110 15 24	1409.6	1531.7	0.87
			325 33 05	Brown's Island	145 33 27	2188.5	2393.3	1.36
San Jacinto	29 44 49.44	W. 7 03 15.61	237 09 03	Pine	57 09 16	854.3	934.2	0.53
			304 26 31	Brown's Island	124 27 07	2371.4	2593.3	1.47
Bay of Anahuac.								
Double Bayou	29 40 21.68	W. 6 40 41.35	22 57 23	Smith's Point	202 55 17	17635.9	19286.1	10.96
			88 45 26	Cedar Point	268 40 08	17294.5	18912.7	10.75

United States Coast Survey.—Geographical Positions. Section IX.—Galveston Bay. Sketch I.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Lone (5) Oaks	29 36 32.14	W. 6 41 17.31	112 17 12	Cedar Point	292 12 12	17641.6	19291.2	10.96
			187 47 21	Double Bayou	7 47 39	7132.9	7800.3	4.43
Lawrence Cove	29 46 16.60	6 45 34.22	324 13 02	Double Bayou	144 15 27	13466.4	14726.5	8.37
			39 36 30	Cedar Point	219 43 36	14718.0	16095.2	9.14
Umbrella Point	29 40 46.17	6 50 47.68	219 36 10	Lawrence Cove	39 38 46	13207.8	14443.7	8.21
			272 36 25	Double Bayou	92 41 25	16318.6	17845.5	10.14
Fisher	29 43 19.13	6 49 53.63	231 53 29	Lawrence Cove	51 55 38	8857.0	9685.8	5.50
			290 09 54	Double Bayou	110 14 28	15819.6	17299.9	9.83
Barrow Beach	29 44 53.13	6 48 16.55	239 28 41	Lawrence Cove	59 30 02	5061.6	5535.0	3.15
			304 18 25	Double Bayou	124 22 11	14816.1	16202.5	9.20
Alligator Bank	29 46 53.66	6 43 54.35	336 43 53	Double Bayou	156 45 29	13125.6	14353.8	8.15
			66 57 35	Lawrence Cove	246 56 45	2914.8	3187.5	1.81
South Pass Trinity River	29 46 18.86	6 41 45.79	351 02 46	Double Bayou	171 03 18	11132.2	12173.9	6.92
			89 22 01	Lawrence Cove	269 20 08	6135.8	6709.9	3.81
Round Point	29 43 57.31	6 40 30.64	2 29 04	Double Bayou	182 28 58	6645.0	7276.8	4.13
			117 45 29	Lawrence Cove	297 42 58	9214.4	10076.6	5.72
Ash Point	29 41 20.36	6 40 26.87	12 09 52	Double Bayou	192 09 46	1848.2	2021.1	1.15
			137 57 37	Lawrence Cove	317 49 04	12304.1	13455.4	7.64
Anahuac	29 46 46.51	6 39 23.73	9 59 26	Double Bayou	189 58 47	12030.1	13155.8	7.48
			84 44 22	Lawrence Cove	264 41 18	9993.4	10928.5	6.21
Barrow's House	29 44 40.72	W. 6 48 34.42	255 17 39	Anahuac	75 22 03	15291.4	16722.2	9.50
			302 03 56	Double Bayou	122 07 51	15008.7	16413.1	9.33

United States Coast Survey.—Geographical Positions. Section IX.—Galveston Bay. Sketch 1.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
McCarty	29 49 21.61	W.6 38 59.19	7 51 28	Anahuac	187 51 16	4820.5	5271.6	3.00
			61 47 35	Lawrence Cove	241 44 19	12040.2	13166.8	7.48
Fort Anahuac	29 45 30.21	6 40 04.70	99 11 19	Lawrence Cove	279 08 35	8965.9	9804.8	5.57
			205 06 07	Anahuac	25 06 27	2593.9	2836.6	1.61
Van Pradelle's House	29 46 29.91	6 40 31.84	254 23 21	Anahuac	74 23 55	1899.5	2077.2	1.18
			338 21 38	Fort Anahuac	158 21 51	1977.2	2162.2	1.23
North Pass Trinity River	29 48 30.39	6 41 25.94	248 10 43	McCarty's	68 11 56	4243.9	4641.0	2.64
			314 15 09	Anahuac	134 16 10	4582.8	5011.6	2.85
Wiggins	29 49 29.27	W.6 40 39.82	274 59 09	McCarty	94 59 59	2711.9	2965.7	1.69
			337 48 43	Anahuac	157 49 21	5411.8	5918.2	3.36
East Bay.								
Elm Grove	29 28 49.05	W.6 38 55.30	19 51 18	Parr's Grove	199 50 42	5858.4	6406.6	3.64
			117 35 35	Smith's Point	297 32 37	10983.0	12010.7	6.83
Stevenson	29 32 50.53	6 38 47.01	9 42 08	Parr's Grove	189 41 28	13132.7	14361.5	8.16
			76 44 07	Smith's Point	256 41 05	10229.9	11187.1	6.36
Shaw	29 27 48.81	6 35 48.18	62 32 57	Parr's Grove	242 30 43	7925.2	8666.8	4.92
			152 36 28	Stevenson	332 34 59	10463.4	11442.5	6.50
Robinson Bayou	29 34 46.98	6 32 46.12	20 51 29	Shaw	200 49 59	13775.9	15064.9	8.56
			69 46 02	Stevenson	249 43 04	10353.8	11322.6	6.43
Rollover	29 30 16.73	W.6 29 16.14	66 41 54	Shaw	246 38 41	11500.1	12576.2	7.15
			145 49 18	Robinson Bayou	325 47 35	1058.7	1157.8	0.66

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Marsh Point	29 31 58.06	W. 6 33 03.20	99 55 25	Stevenson	279 52 36	9395.7	10274.9	5.84
			185 03 03	Robinson Bayou	15 03 11	5220.6	5709.1	3.24
Shell Bank	29 33 11.70	6 30 25.97	61 50 03	Marsh Point	241 48 46	4801.5	5250.8	2.98
			127 52 45	Robinson Bayou	307 51 36	4778.1	5225.2	2.97
Muscle Point	29 32 05.81	W. 6 38 03.26	88 19 43	Marsh Point	268 17 15	8078.7	8834.6	5.02
			30 18 18	Rollover	210 17 42	3889.5	4253.5	2.42
West Bay.								
Highland Bayou	29 21 12.94	W. 6 58 48.31	229 54 31	Dollar Point	49 57 44	13855.1	15151.5	8.61
			289 06 19	Virginia Point	109 09 33	11302.9	12360.5	7.02
Island, East Base	29 12 52.58	6 54 38.11	198 34 05	Virginia Point	18 35 17	16818.9	18392.7	10.45
			156 20 46	Highland Bayou	336 18 44	12342.5	13497.4	7.67
Hall's Bayou	29 17 21.23	7 03 36.27	299 36 50	Island, East Base	119 41 13	16717.7	18282.0	10.39
			227 25 17	Highland Bayou	47 27 38	10547.1	11534.0	6.55
Island, West Base	29 08 46.21	7 00 51 64	233 02 40	Island, East Base	53 05 42	12623.6	13804.8	7.84
			164 20 49	Hall's Bayou	344 19 29	16466.8	18007.6	10.23
Black Point	29 14 51.60	6 58 53.86	297 55 47	Island, East Base	117 57 52	7817.6	8549.1	4.86
			180 43 52	Highland Bayou	0 43 55	11741.1	12839.7	7.29
Eagle Grove	29 17 29.64	6 50 42.57	36 43 19	Island, East Base	216 41 24	10638.9	11634.4	6.61
			142 35 31	Virginia Point	322 34 47	3991.2	4364.7	2.48
Slaughter House	29 13 56.94	W. 6 51 58.25	65 21 38	Island, East Base	245 29 20	4750.0	5194.5	2.95
			140 31 37	Highland Bayou	320 28 08	17396.2	19024.0	10.81

United States Coast Survey.—Geographical Positions. Section IX.—Galveston Bay. Sketch I.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Beach	29 13 57.96	W. 6 51 42.17	67 03 18	Island, East Base	247 01 52	5160.1	5642.9	3.21
			175 10 51	Virginia Point	355 10 36	9721.1	10630.7	6.04
Middle Deer Island	29 16 46.62	6 53 51.89	135 43 56	Highland Bayou	315 41 31	11453.5	12525.2	7.12
			210 50 05	Virginia Point	30 50 54	5234.6	5724.4	3.25
Spillman	29 17 33.40	6 55 58.98	145 57 25	Highland Bayou	325 56 02	8157.8	8921.1	5.07
			243 26 07	Virginia Point	63 27 58	6833.4	7472.8	4.25
Settle's House, (chimney)	29 12 27.98	6 55 54.23	132 21 36	Black Point	312 20 09	6563.5	7177.7	4.08
			249 45 49	Island, East Base	69 46 26	2190.8	2395.8	1.36
Green's House	29 16 14.64	6 57 50.76	320 05 05	Island, East Base	140 06 39	8108.5	8867.2	5.04
			33 40 47	Black Point	213 40 17	3072.1	3359.6	1.91
Delesdernier's	29 10 21.13	6 58 12.11	172 17 25	Black Point	352 17 05	8402.3	9188.5	5.22
			231 05 49	Island, East Base	51 07 33	7426.6	8121.5	4.61
Caronkaway Island	29 12 26.33	6 58 17.87	167 44 20	Black Point	347 44 02	4576.6	5004.8	2.84
			262 13 44	Island, East Base	82 15 32	5989.8	6550.3	3.72
Caronkaway Point	29 12 53.13	7 00 39.02	217 53 55	Black Point	37 54 46	4622.0	5054.5	2.87
			2 34 00	Island, West Base	182 33 54	7609.2	8321.2	4.73
Mustang Bayou	29 11 47.85	7 06 20 18	302 13 04	Island, West Base	122 15 44	10494.2	11476.1	6.52
			244 51 05	Black Point	64 54 43	13310.9	14556.4	8.27
West End	29 05 21.95	7 05 33.00	230 23 59	Island, West Base	50 26 16	9868.8	10792.2	6.12
			173 52 55	Mustang Bayou	353 52 32	11954.8	13073.4	7.43
Dr. Jones	29 07 05.47	W. 7 03 11.41	50 13 59	West End	230 12 50	4981.1	5447.2	3.09
			149 37 45	Mustang Bayou	329 36 13	10084.9	11028.5	6.27

United States Coast Survey.—Geographical Positions. Section IX.—Galveston Bay. Sketch I.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Ayres	29 10 34.41	W.7 07 52.00	338 39 28	West End	158 40 36	10326.8	11293.1	6.42
			227 33 46	Mustang Bayou	47 34 31	3360.7	3675.2	2.09
Mezquit	29 07 47.72	7 08 30.31	313 06 01	West End	133 07 27	6566.0	7180.4	4.08
			205 24 33	Mustang Bayou	25 25 37	8192.3	8958.9	5.09
Bastrop	29 06 28.21	7 10 07.00	285 22 39	West End	105 24 52	7683.8	8402.8	4.77
			211 53 12	Mustang Bayou	31 55 03	11598.7	12684.0	7.21
Peninsula	29 01 22.84	7 10 14.14	181 10 35	Bastrop	1 10 38	9403.0	10282.8	5.84
			225 54 42	West End	45 56 59	10583.5	11573.8	6.58
Christmas Point	29 04 51.04	W.7 09 06.32	15 58 35	Peninsula	195 58 02	6667.0	7290.8	4.14
			260 37 08	West End	80 38 52	5846.1	6393.1	3.63
Oyster Bay.								
San Louis	29 04 19.41	W.7 06 56.37	127 34 52	Bastrop	307 33 19	6503.3	7111.8	4.04
			44 33 25	Peninsula	224 31 49	7627.0	8340.7	4.74
Mud Island	29 05 43.38	7 07 34.10	108 28 27	Bastrop	288 27 13	4358.3	4766.1	2.71
			28 22 01	Peninsula	208 20 43	9114.3	9967.1	5.66
Follet	29 02 30.11	7 09 00.46	166 12 40	Bastrop	346 12 08	7547.6	8253.8	4.69
			43 54 36	Peninsula	223 54 00	2874.6	3143.5	1.69
Freshwater	29 03 14.94	7 11 30.36	200 44 35	Bastrop	20 45 16	6362.6	6958.0	4.07
			329 08 19	Peninsula	149 08 56	4020.1	4396.3	2.49
Cottonwood	29 04 34.18	W.7 13 41.48	316 23 27	Peninsula	136 25 08	8133.4	8894.5	5.05
			238 47 48	Bastrop	58 49 32	6779.0	7413.3	4.21

United States Coast Survey.—Geographical Positions. Galveston Bay.—Section IX. Sketch I.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Rattlesnake	28 58 37.69	W. 7 14 05.00	183 19 01	Cottonwood	3 19 02	10992.7	12021.3	6.83
			230 50 55	Peninsula	50 52 47	8054.7	8808.4	5.01
Oyster Creek	28 59 30.87	7 16 24.98	205 20 16	Cottonwood	25 21 35	10331.9	11298.7	6.42
			251 01 10	Peninsula	71 04 10	10610.6	11603.4	6.60
Benson	29 01 05.82	7 11 48.51	154 32 04	Cottonwood	334 31 09	7105.0	7769.8	4.41
			258 23 56	Peninsula	78 24 42	2606.6	2850.5	1.62
Chocolate	29 12 18.87	7 10 17.33	229 17 21	Hall Bayou	49 20 37	14279.2	15615.1	8.87
			293 08 59	Island, West Base	113 13 35	16626.7	18182.5	10.33
Alligator Head	29 10 30.21	W. 7 04 41.71	187 56 46	Hall Bayou	7 57 18	12776.2	13971.7	7.94
			297 14 00	Island, West Base	117 15 53	6992.7	7647.0	4.34

United States Coast Survey.—Geographical Positions. Section X.—Coast of California. Sketch J, No. 10.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
SAN DIEGO BAY.	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
SAN DIEGO BASE, East End	32 41 17.91	E. 0 01 50.63	....	....	....	....	....	....
SAN DIEGO BASE, West End	32 41 40.92	0 01 05.52	301 05 29.2	East Base	121 05 53.6	1372.1	1500.5	0.85
Ballast Point	32 41 04.92	0 00 33.38	258 44 52.4	East Base	78 45 34.1	2051.7	2243.7	1.28
			217 03 24.0	West Base	37 03 41.4	1388.1	1518.0	0.86
Playa	32 42 09.81	0 00 10.78	301 34 14.1	East Base	121 35 08.0	3052.8	3338.5	1.90
			343 35 22.0	Ballast Point	163 35 34.3	2083.6	2278.6	1.30
Point Loma	32 40 13.34	0 00 05.41	234 01 43.7	East Base	54 02 40.5	3386.6	3703.5	2.10
			182 13 57.4	Playa	2 14 00.3	3590.2	3926.1	2.23
Fitch's Hill	32 42 56.62	E. 0 00 09.53	319 06 03.0	East Base	139 06 57.6	4022.1	4398.5	2.50
			1 13 27.1	Point Loma	181 13 24.9	5030.5	5501.2	3.13
Observatory, Transit	32 41 57.96	0 00 00.00	293 03 26.1	East Base	113 04 25.9	3131.9	3425.0	1.95
		117 13 22.00	187 47 36.6	Fitch's Hill	7 47 41.8	1830.4	2001.7	1.14
Observatory, Azimuth Point	32 41 57.75	W. 0 00 00.11	293 02 12.4	East Base	113 03 12.2	3134.7	3428.0	1.95
			187 53 15.0	Fitch's Hill	7 53 20.2	1830.7	2002.0	1.14
Old Town	32 44 57.26	E. 0 03 22.54	19 30 39.9	East Base	199 29 50.2	7167.6	7838.3	4.45
			53 31 55.2	Fitch's Hill	233 30 10.8	6249.4	6834.2	3.88
Black Fish Point	32 40 41.57	E. 0 03 52.66	125 36 46.5	Fitch's Hill	305 34 46.0	7146.7	7815.4	4.44
			81 39 42.5	Point Loma	261 37 39.9	5983.7	6543.6	3.72
			174 18 53.6	Old Town	354 18 37.3	7914.6	8655.2	4.92
False Bay	32 44 02.53	W. 0 00 10.85	328 01 51.6	East Base	148 02 57.2	5976.3	6535.5	3.71
			253 06 04.8	Old Town	73 08 00.1	5805.0	6348.2	3.61

United States Coast Survey.—Geographical Positions. Section X.—Coast of California. Sketch J, No. 10.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Indian Point	32 41 25.21	E. 0 06 10.07	146 16 33.1	Old Town	326 15 02.5	7854.4	8589.3	4.88
			76 54 40.2	Point Loma	256 51 23.0	9753.7	10666.4	6.06
			69 25 55.2	Black Fish Point	249 24 41.0	3823.2	4180.9	2.37
New Town	32 43 26.07	0 04 45.83	82 50 09.9	Fitch's Hill	262 47 40.6	7251.2	7929.7	4.51
			15 17 26.5	Black Fish Point	195 16 57.8	5252.6	5744.1	3.26
			329 29 09.5	Indian Point	149 29 55.0	4321.1	4725.4	2.68
Beach I	32 39 06.81	0 05 26.39	140 05 22.8	Black Fish Point	320 04 32.2	3805.9	4160.0	3.36
			194 56 30.6	Indian Point	14 56 54.2	4412.0	4824.8	2.74
Choya Point	32 39 34.57	0 07 37.88	146 08 09.3	Indian Point	326 07 21.9	4104.3	4488.3	2.55
			75 59 47.9	Beach I	255 58 36.9	3531.0	3861.4	1.20
Point San Augustin	32 38 10.17	0 07 46.14	115 36 28.7	Beach I	295 35 13.3	4038.0	4415.8	2.51
			175 16 02.2	Choya Point	355 15 57.7	2608.5	2852.6	1.62
Beach II	32 36 24.06	0 06 34.20	160 35 07.0	Beach I	340 34 30.4	5315.5	5812.9	3.30
			209 50 11.4	Point San Augustin	29 50 50.2	3768.1	4120.7	2.34
Santiagito	32 35 46.85	0 09 09.86	105 46 44.9	Beach II	285 45 21.0	4211.3	4605.4	2.61
			153 41 52.7	Point San Augustin	333 41 07.6	4924.5	5385.3	3.06
Bluff Point	32 35 48.28	E. 0 07 10.67	139 12 26.2	Beach II	319 12 06.6	1339.7	1465.1	0.83
			191 56 24.4	Point San Augustin	11 56 43.6	4467.0	4885.0	2.78
Point Conception, Coast Survey Observatory	34 26 56.30	120 25 33.00	....	(Sketch J, No. 3)	....	....	....	....
Point Pinos, Coast Survey Observatory, near Monterey	36 37 59.86	121 54 22.00	....	(Sketch J, No. 4)	....	....	....	....

United States Coast Survey.—Geographical Positions. Section X.—Coast of California. Sketch J, No. 9.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
SAN FRANCISCO BAY.	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Point Avisidera	37 43 30.57	E. 0 06 00.74	....	....	....	....	....	....
Yerba Buena	37 48 33.46	0 05 53.15	358 51 39	Point Avisidera	178 51 44	9339.5	10213.4	5.80
Angel Island	37 51 39.40	E. 0 01 59.68	....	....	....	....	....	....
Presidio Hill	37 47 35.60	0 00 00.00	258 18 09	Yerba Buena	78 21 45	8820.6	9645.9	5.48
		122 26 47.65	201 15 52	Angel Island	21 17 05	8065.3	8820.0	5.01
Point San José	37 48 23.29	E. 0 02 10.02	266 41 29	Yerba Buena	86 43 46	5466.4	5977.9	3.40
			177 36 18	Angel Island	357 36 12	6050.8	6617.0	3.76
Fort Point	37 48 26.75	W. 0 00 45.53	324 45 53	Presidio Hill	144 46 21	1930.4	2111.0	1.20
			271 24 33	Point San José	91 26 21	4295.1	4697.0	2.67
Point Lobos	37 47 12.02	0 02 15.98	257 39 33	Presidio Hill	77 40 56	3405.0	3723.6	2.12
			....	....	....	....	....	....
Point Boneta	37 49 09.73	0 04 00.89	285 28 58	Fort Point	105 30 58	4958.3	5422.2	3.08
			324 43 22	Point Lobos	144 44 26	4444.7	4860.6	2.76
South Farallone	37 41 43.70	W. 0 32 28.10	....	....	....	....	....	....

APPENDIX No. 13.

Letter of the Secretary of the Treasury, communicating to the Superintendent of the Coast Survey the act of Congress requiring examinations to be made in relation to light-houses, light-boats, beacons, buoys, &c.

TREASURY DEPARTMENT,
March 29, 1851.

SIR: S. Pleasonton, esq., the general superintendent of the light-house establishment, having reported to me that preliminary surveys, as required by 2d, 3d, and 4th sections of an act entitled "An act making appropriations for light-houses, light-boats, buoys, &c., and providing for the erection and establishment of the same, and for other purposes," approved the 3d March, 1851, are necessary to determine the sites and ascertain more fully what is required by the public exigencies, in reference to all the light-houses, light-boats, beacons, and buoys, for which appropriations are made by the act requiring that the Superintendent of the Coast Survey shall perform this duty on the seaboard, you are directed to cause such examination to be made as will enable you to furnish the information particularly suggested in the 3d section of the act, on the seacoast of Maine, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Maryland, North Carolina, Florida, Texas, California, and Oregon.

A newspaper containing the act of Congress herein referred to, the places to be examined, and the objects to be obtained from such examination, is herewith enclosed. When the several localities have been visited, and such examination made as will enable you to comply with the requirements of the act, you will make report to this department of the result of such examinations, having special regard to the inquiries suggested in the 3d section of the act, in every case of proposed expenditure.

It is desirable that this report should describe the kind of structure, or other improvement, authorized by the act which you would recommend for adoption, and be accompanied by sketches indicating the precise points where they should be placed; and when it is necessary to purchase the sites, the names of the owners should also be stated.

Very respectfully, your obedient servant,

W. L. HODGE,
Acting Secretary of the Treasury.

Prof. A. D. BACHE,
Superintendent U. S. Coast Survey.

AN ACT making appropriations for light-houses, light-boats, buoys, &c., and providing for the erection and establishment of the same, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following appropriations be, and the same are hereby made, and directed to be paid out of any money in the treasury not otherwise appropriated, to enable the

Secretary of the Treasury to carry the provisions of this act into effect: *Provided*, *however*, If a good title to any land which it may be necessary to use cannot be obtained on reasonable terms, or the exclusive right to such land as cannot be acquired by cession, when the interest of the United States demands it, before the appropriation would by law fall into the surplus fund, in any and all such cases the appropriations shall be applicable to the objects for which they are made, at any time within two years after the first meeting of the legislature in any State wherein such land may be situated, subsequent to the passage of this act, to wit:

MAINE.

For buoys on White's and Thom's ledges, and on Pond Island reef, at the mouth of the Kennebec river, three hundred dollars.

For a light-house on Pond island, at the entrance of Narraguagus bay, four thousand dollars.

MASSACHUSETTS.

For a light-boat on the Shovelful shoals, off Chatham, twelve thousand five hundred dollars.

For eleven buoys in the channel to Commercial Point and Neponset river, in Dorchester, one thousand dollars.

For a light-house at the head of Holmes' Hole harbor, three thousand five hundred dollars.

For a beacon on Fawn bar, near Deer island, Boston harbor, two thousand five hundred dollars.

For two iron spindles on the northeast ledge of the Graves, and on Holmes' ledge, Boston harbor, two thousand dollars.

RHODE ISLAND.

For a light-boat off Brenton's reef, fifteen thousand dollars.

CONNECTICUT.

For a can-buoy on Peafield reef, off Black Rock harbor, in Long Island sound, in addition to a former appropriation in the act of September, eighteen hundred and fifty, one hundred and thirty-five dollars.

NEW YORK.

For a light-house on Flynn's knoll, near Sandy Hook, thirty thousand dollars.

For a light-house on Horse Shoe reef, Niagara river, twenty-five thousand dollars, in addition to the former appropriations.

For a light-house on the pier, at the mouth of Sodus bay, and the removal of the beacon light on said pier to Grassy Point, near Point Glasgow, six thousand dollars.

For a light-house on the northern extremity of Gardiner's island, six thousand dollars.

For a beacon on the Sand spit in the harbor of Sag Harbor, seven hundred dollars.

For the completion of two beacons near Fort Hamilton, two thousand dollars.

For four spar-buoys at Fire Island inlet, three hundred dollars.

MARYLAND.

For a light-house at Fishing Battery, Chesapeake bay, five thousand dollars.

For a light-house on the Bodkin shoal, mouth of the Patapsco river, in addition to the former appropriation, seventeen thousand dollars. (When this is completed, the present light on Bodkin Point to be discontinued.)

NEW JERSEY.

For a fog-bell at the Newark light-house, two hundred and fifty dollars.

For completion of the beacon in Passaic river, four spar-buoys in the same, a spar-buoy at Mill Rock, and a beacon at the Corner Stake, near Elizabethtown Point, eight hundred dollars.

NORTH CAROLINA.

For a buoy on Middle Ground shoal, Beaufort harbor, two hundred dollars.

For a light-house on Beacon island, six thousand dollars.

For a light-boat near Ocracoke channel, fifteen thousand dollars.

For an iron-buoy on Diamond shoal, off Cape Hatteras, eight hundred dollars.

For a floating bell-beacon on Cape Hatteras outer shoals, eight thousand dollars.

For a light-house on the Upper Jettee, in Cape Fear river, including a bridge from the shore to the light-house, thirteen thousand dollars.

OHIO.

For a light-house on Rock or Mouse island, Lake Erie, five thousand dollars.

For a light-house on Green island, Lake Erie, five thousand dollars.

For a beacon-light on Cedar Point, as a range to enter Sandusky bay, five hundred dollars.

For buoys at the entrance of Port Clinton, Lake Erie, two hundred and fifty dollars.

MICHIGAN.

For a light-house at Bengley's harbor, five thousand dollars.

FLORIDA.

For buoys at the entrance of Musquito harbor, five hundred dollars.

OREGON.

For a light-house and fog-signal at Umqua, fifteen thousand dollars.

For fog-signals for the light-houses at Cape Disappointment, Cape Flattery, and New Dungeness, three thousand dollars.

CALIFORNIA.

For a light-house at Humboldt harbor, fifteen thousand dollars.

TEXAS.

For a light-house at Aransas Pass, twelve thousand five hundred dollars.

For three light-houses of the third class at Half Moon shoal, Red Fish bar, and at Clopper's bar, Galveston bay, fifteen thousand dollars.

Sec. 2. *And be it further enacted*, That if such person as the Secretary of the Treasury shall designate shall report, in any of the cases herein provided for, that preliminary surveys are necessary to determine the site of a proposed light-house, or light-boat, beacon, or buoy, or to ascertain more fully what the public exigency demands, the Secretiary of the Treasury shall therefore direct the Superintendent of the survey of the coast of the United States to perform such duty on the seaboard, and the colonel of the corps of topographical engineers to perform such duty on the northwestern lakes.

Sec. 3. *And be it further enacted*, That the officer so directed shall forthwith enter upon the discharge of the duty; and after fully ascertaining the facts, shall report: First, whether the proposed facility to navigation is the most suitable for the exigency which exists; and, second, where it should be placed if the interests of commerce demand it: Third, if the thing proposed be not the most suitable, whether it is expedient to make any other kind of improvement: Fourth, whether the proposed light has any connexion with other lights, and if so, whether it cannot be so located as to subserve both the general and the local wants of trade and navigation; and, fifth, whether there be any, and if any, what other facts of importance touching the subject.

Sec. 4. *And be it further enacted*, That all such reports shall, as speedily as may be, be laid before the Secretary of the Treasury; and if such as to authorize the work without further legislation, he shall forthwith proceed with it, otherwise such reports shall be laid before Congress at the next ensuing session; but, in all cases where the person designated by the Secretary of the Treasury, under the second section of this act, does not report such preliminary examination as expedient, the provisions of this ac* shall without delay be carried into execution.

Sec. 5. *And be it further enacted*, That the salary of the keeper of the Minot's Ledge light shall hereafter be at the rate of one thousand dollars per annum, and the assistants five hundred and fifty dollars per annum.

Sec. 6. *And be it further enacted*, That in case it should be impossible, in the opinion of the colonel of the topographical corps, to obtain a perfect title to the necessary land upon which to build the light-house heretofore ordered to be built at the mouth of the Calumet river, on Lake Michigan, said land shall be appraised by three disinterested persons, under oath, and the light-house shall immediately be built, and the appraised value of said land shall be paid to any person who shall make to the United States what the Attorney General shall consider a perfect title thereto.

Sec. 7. *And be it further enacted*, That hereafter in all new light-houses, and in all light-houses requiring new lighting apparatus, and in all light-houses as yet unsupplied with illuminating apparatus, the lens or Fresnel system shall be adopted, if, in the opinion of the Secretary of the Treasury, the public interest will be subserved thereby.

Sec. 8. *And be it further enacted*, That the Secretary of the Treasury be, and is hereby, authorized and required to cause a board to be convened, at as early a day as may be practicable, after the passage of this act, to be composed of two officers of the navy of high rank, two officers of engineers of the army, and such civil officer of high scientific attainments as may be under the orders or at the disposition of the Treasury Department, and a junior officer of the navy to act as secretary to said board, whose duty it shall be, under instructions from the Treasury Department, to inquire into the condition of the light-house establishment of the United States, and make a general detailed report and programme to guide legislation, in extending and improving our present system of construction, illumination, inspection, and superintendence: *Provided*, That no additional compensation shall be allowed any person serving on said board.

Sec. 9. *And be it further enacted*, That the President be, and is hereby, required to cause to be detailed from the engineer corps of the army, from time to time, such officers as may be necessary to superintend the construction and renovating light-houses.

Approved March 3, 1851.

APPENDIX No. 14.

Letters of the Superintendent of the Coast Survey to the Secretary of the Treasury, applying for information in regard to the light-house matters referred to in the act of Congress.

Coast Survey Office, *March* 31, 1851.

Sir: I have the honor to acknowledge the receipt of yours of March 29, informing me that the Fifth Auditor had reported that preliminary surveys are required in reference to all the light-houses, light-boats, beacons, and buoys, for which appropriations are made by the act of

March 3d, 1851, and directing me, in pursuance of the law, to cause the necessary examinations to be made, and to report what the public exigency demands in the matter.

It is desirable in the execution of the law, and of your instructions, that such papers as may be in the possession of the department, giving information in regard to the necessity for these several objects referred to in the act, should be examined in this office. I would therefore request that you will give the necessary direction for their transfer to me, to be returned when the report is made.

Yours, respectfully,

A. D. BACHE,
Superintendent U. S. Coast Survey.

Hon. W. L. Hodge,
Acting Secretary of the Treasury.

Coast Survey Office,
Washington City, April 1, 1851.

Sir: I would respectfully request to be informed which of the light-houses and beacons, for which appropriations were made by the act approved March 3, 1851, have been commenced.

Very respectfully, yours,

A. D. BACHE,
Superintendent U. S. Coast Survey.

Hon. W. L. Hodge,
Acting Secretary of the Treasury.

APPENDIX No. 14, *bis.*

Letters from the Secretary of the Treasury to the Superintendent of the Coast Survey, communicating reports from the Fifth Auditor, in relation to light-house matters referred to in the act of Congress.

Treasury Department,
April 3, 1851.

Sir: I transmit for your information, and as a reply to the inquiry made in your letter of the 1st instant, an extract from a letter addressed to the department by S. Pleasonton, esq.

I am, very respectfully, your obedient servant,

WM. L. HODGE,
Acting Secretary of the Treasury.

Prof. A. D. Bache,
Superintendent Coast Survey, Washington.

TREASURY DEPARTMENT,
Fifth Auditor's Office, April 3, 1851.

SIR: In answer to your note of the 2d instant, just received, I have the honor to inform you that no step has been taken by me for building any of the light-houses, or light-vessels, for which appropriations were made on the 3d March last; considering it necessary that the several sites should be previously examined and reported upon by the officers to be appointed for the purpose.

And with respect to three which it had been previously determined to build, and for which additional appropriations were necessary, and were made by that act, I was prevented from taking any step towards building them, by a clause in the act requiring the President to cause to be detailed engineers of the army for the purpose of superintending the construction and renovation of light-houses.

I have the honor to be, sir, respectfully, your obedient servant,

S. PLEASONTON.

WM. L. HODGE, Esq.,
Acting Secretary of the Treasury.

TREASURY DEPARTMENT,
April 5, 1851.

SIR: In further reply to your letter of the 1st instant, I enclose a copy of a letter from the Fifth Auditor, under date of the 2d instant.

Very respectfully, your obedient servant,

WM. L. HODGE,
Acting Secretary of the Treasury.

Prof. A. D. BACHE,
Superintendent U. S. Coast Survey, Washington, D. C.

TREASURY DEPARTMENT,
Fifth Auditor's Office, April 2, 1851.

SIR: In reply to your note of the 1st instant, requesting me to furnish Professor Bache with such papers as may be in this office giving information as to the necessity and importance of constructing the light-houses and light-boats for which appropriations were made by the light-house law of the 3d March last, I have to state that with three exceptions, which I shall state, I have no knowledge of the reasons on which the several appropriations were made. The Committee on Commerce of the House of Representatives reported the bill, which was not printed, the last night of the session. I had no knowledge of it until passed into a law. It is presumed the committee made the appropriation upon the application of individuals of which I have no knowledge. Hence I can give Professor Bache no information that would aid him, or the officers under him, in forming an opinion as to the expediency, or otherwise, of building the light-houses, light-boats, buoys, &c., for which appropriations are made. The necessity for the

examination is apparent, however, from the many lights on the coast and lakes, and the fact that, on some parts of the coast, the lights are now so numerous that it is impossible to distinguish one from another, and they are hence becoming a nuisance.

The exceptions referred to above are, the three additional appropriations recommended by this office, viz: For the light-house on Horse Shoe reef, Niagara river, $25,000; for a light-house on Bodkin shoal, mouth of the Patapsco, (seven-foot knoll,) $17,000 dollars; for a light-house at the upper jettee, Cape Fear river, including a bridge from the shore to the light-house, $13,000. These are works which it has been determined to prosecute, and need not, therefore, be examined.

I have the honor to be, sir, respectfully, your obedient servant,

S. PLEASONTON.

William L. Hodge, Esq.,
Acting Secretary of the Treasury.

APPENDIX No. 15.

Table showing the results of examinations for sites of light-houses, beacons, buoys, &c., referred to the Superintendent of the Coast Survey by the Secretary of the Treasury, in accordance with acts of Congress.

Section.	State.	No.	Special locality.	Object recommended.	By whom examined.	Report of superintend'nt.
I	Maine	1	White's and Thom's ledges	Buoys	Lieut. Comm'g Woodhull	Recommended July 28
			Pond Island reef, mouth of Kennebec	do	do do	Recommended July 28
		2	Pond island, Narraguagus bay	Light-house	do do	Recommended July 28
	Massachusetts	3	Shovelful shoals, near Chatham	Light-boat	do do	Recommended Sept. 1
		4	Channel to Commercial point and Weponset river	Buoys	Lieutenant McBlair	Recommended April 29
		5	Holmes's Hole, Martha's Vineyard	Bug-lights	do do	Recommended July 19
		6	Fawn bar ... Boston harbor	Beacon	do do	Recommended April 29
		7	Harding's ledge and the Graves, do	Spindles, with cones	do do	Recommended April 29
	Rhode Island	8	Off Brenton's reef, Narragansett bay	Light-boat	do do	Recommended April 29
II	Connecticut	9	Peafield reef, off Black rock	Can-buoys	Lieuts. Jenkins and Woodhull.	Recommended June 13
	New York	10	Flynn's knoll, Sandy Hook	Light-house	Light-house Board	Not recommended.
		11	Northern extremity of Gardiner's island	do	Lieuts. Jenkins and Woodhull.	Recommended June 13
		12	Sand spit in Sag Harbor	Beacon	do do do	Recommended June 13
		13	Fort Hamilton	Beacons	do do do	Recommended June 13
		14	Fire Island inlet, Long Island	Spar-buoys		Recommended April 29
	New Jersey	17	Newark light-house	Fog-bell	Lieuts. Jenkins and Woodhull.	Recommended June 13
			Passaic river, near	Spar-buoys	do do do	Already placed.
			Passaic river	Beacon	do do do	Recommended June 13
			Mill Rock	Buoy	do do do	Already placed.
			Elizabethtown point	Beacon	do do do	Recommended June 13
	Maryland	15	Fishing battery, Chesapeake bay	Light-house	Lieutenant Almy	Recommended Nov. 20
		16	Bodkin shoal, Patapsco river	do		Recommended April 29
IV	North Carolina	19	Middle Ground shoal, Beaufort harbor	Buoy	Lieut. Commanding Jenkins	Recommended April 29
		20	Beacon island	Light-house	do Maffit	Ex'n made, but report not received Nov. 28.
		21	Ocracoke channel	Light-boat	do do.	
		22	Diamond shoal, off Cape Hatteras	Buoy	do Jenkins	Recommended April 29

STATEMENT—Continued.

Section.	State.	No.	Special locality.	Object recommended.	By whom examined.	Report of superintend'nt.
IV	North Carolina	23	Outer shoal, off Cape Hatteras	Floating bell beacon	Lieut. Commanding Jenkins	Recommended April 29
		24	Upper jettee, Cape Fear river	Light-house	do Maffitt	Recommended Oct. 15
VI	Florida	25	Mosquito inlet, near Mount Pleasant	Buoys	do Rodgers	Recommended Oct. 1
IX	Texas	29	Aransas pass, near South breakers	Light-house	do Craven	Not recommended.
		30	Half Moon shoal	do	do do	Recommended June 17
			Red Fish bar	do	do do	Recommended June 17
			Clopper's bar, San Jacinto river	do	do do	Recommended June 17
X	California	28	Humboldt harbor, North spit	do	do Alden	Recommended Nov. 19
			Fort Point, San Francisco bay	do	Assistant Cutts	Recommended Feb. 13
			Alcatraz, or Bird island	do	do do	Recommended Feb. 13
			Point Conception	do	Sub-Assistant Harrison	Recommended Mar. 13
			Point Pinos	do	do do	Recommended Mar. 14
XI	Oregon	26	Umpqua	do	Lieut. Commanding Alden	Report not rec'd Nov. 28
			Umpqua	Fog-signal	do do	Report not rec'd Nov. 28
		27	Cape Hancock, or Disappointment	Light-house and fog-signal.	Lieutenant Bartlett and Sub-Assistant Harrison.	Recommended Sept. 29
			Cape Flattery	do do	Lieut. Commanding McArthur	Recommended April 29
			New Dungeness	do do	do do	Recommended April 29

APPENDIX No. 16

Letter of the Superintendent to the chiefs of hydrographic parties in the coast survey, enclosing a communication from the secretary of the Light-house Board, asking for suggestions for the improvements and extension of the present light-house establishment, and extracts from their replies.

COAST SURVEY STATION,
Near Portland, Maine, July 30, 1851.

SIR: I have to call your attention to the enclosed communication from the secretary of the Light-house Board, and to ask such information in relation to the subjects embraced in it as your especial experience on the coast survey, or general experience as a seaman, may enable you to furnish. I would suggest that specific answers be framed, when the subjects come within the range of your experience, to the questions addressed, adding such remarks as the introductory part of the letter seems to contemplate. Please address your reply, as a report, to me at Portland, Maine.

Yours respectfully,
A. D. BACHE, *Superintendent, &c.*

TO CHIEFS OF HYDROGRAPHIC PARTIES in Coast Survey.

Extracts from letter of Lieutenant Commanding C. H. McBlair, United States navy, assistant in coast survey, in reply to above letter of the Superintendent, in relation to lights, beacons, and buoys needed on the coast of Massachusetts—Section I.

U. S. SURVEYING STEAMER BIBB,
New Bedford, August 28, 1851.

SIR: I have received your letter of the 30th ultimo, directing my attention to the enclosed communication from the Secretary of the Light-house Board, on subjects belonging to improvements in the navigation of our coast. * * * * *

"Additional lights, buoys, beacons, &c., that may be required to render navigation safe and easy."

The following objects seem to me worthy of the consideration of the Light-house Board:

a. The expediency of substituting a light-house on the ledge called "Sow and Pigs," standing near the entrance into Buzzard's bay, for the present light-boat moored in that vicinity, and the light-house on the western side of Cuttyhunk island. The ledge in question is said to be capable of affording a solid foundation of rock for such a structure, and a light of the highest range and power at this point would be invaluable to vessels passing into Buzzard's bay, the Vineyard sound, or bound westward into Long Island sound.

* * * * * * * *

c. Placing a floating beacon, with a fog-bell attached, on Davis' new South shoal.

This shoal lies near the most frequented parts of the ocean, and has occasioned some very disastrous wrecks. It has as little as eight feet water upon it—is swept by very strong tides, and, during the summer

months, almost constantly hidden by fogs. It was designed at one time to erect a beacon upon it, but the great difficulties of the undertaking, arising from the character of the climate and the distance of the nearest port, seem to be regarded as insuperable. It is, however, indispensable to the safety of passing vessels that it should be marked in as distinct a manner as circumstances will admit.

d. A buoy-boat (hereafter to be described) on the Great Rip, one of the most extensive of the Nantucket shoals. A suitable place for this mark would be in the slue or passage near the south end. I would here indicate the shoal itself, the passage in which it was moored, and that on either side of the Rip.

e. A buoy-boat on the small shoal lying to the eastward of the northern end of the Bass Rip, (Nantucket shoals,) to mark the shoal itself and indicate the passage generally between the Bass and Great Rip.

f. A spar-buoy (hereafter to be described) on the sand-spit projecting from Fox's point, (Nashawena island,) at the southern entrance into Quick's Hole. This channel, connecting the Vineyard sound with Buzzard's bay, is constantly used, and the want of a mark showing the spit has occasioned frequent wrecks.

g. A light-boat near Brenton's reef, at the mouth of Newport harbor, already recommended in a special report to you.

h. Three small harbor-lights, to facilitate the entrance into Holmes' Hole harbor, already particularly described in my report to you of the 16th ultimo.

i. Certain spindles, buoys, and beacons, marking the approaches near Dorchester and Boston, already enumerated and described in my reports to you, dated March 1st.

j. A wooden beacon, painted black, on Long island, (Boston harbor,) placed so as to range with the northeast end of Spectacle island, for the safe navigation of the *main* ship channel. For particulars respecting this mark, I beg to refer you to Lieutenant Charles H. Davis' report to you on the subject, of December 24, 1847.

k. A similar beacon on the southeast part of Long island, (Boston harbor,) to range with "Nix's Mate," in order to facilitate the passage through the Broad Sound south channel. In the Coast Survey sailing directions, the range that has been given to answer the same end, is "Nix's Mate on Blue Hill;" but owing to the distance of the latter object, this guide is only available in clear weather. The substituton of the beacon on Long island for Blue Hill, is recommended at the instance of Lieutenant Davis.

l. A buoy-boat on the southwest end of Billingsgate shoal, (Massachusetts bay,) and two spar-buoys on the southern edge of the shoal, planted at regular intervals between the boat and Billingsgate island. Three guides are necessary in the approach to the anchorage under Billingsgate shoal.

m. A spar-buoy on or near a small rock lying to the southward of Wellfleet harbor, and called, on the hydrographical sheet, "Bibb Rock."

* * * * * * * *

Respectfully,

C. H. McBLAIR,

Lieutenant Commanding, and Assistant Coast Survey.

Extracts from letter of Lieutenant Commanding S. Swartwout, United States navy, assistant in coast survey, in reply to foregoing letter of the Superintendent, in relation to lights, beacons, and buoys needed on the coast of Massachusetts—Section I.

U. S. Surveying Brig Washington,
Off Nantucket Bar, September 4, 1851.

Sir: Your circular letter, dated July 30th, enclosing a communication from the secretary of the Light-house Board, reached me in due course of mail. * * * * * * *

"Additional lights, buoys, beacons, &c., that may be required to render navigation safe and easy."

I am only prepared to answer this question so far as it relates to this particular section of our coast. * * * * *
* * * * * * * * *

A floating beacon, with a fog-bell attached, on Davis' South shoal.

A buoy-boat (to be hereafter described) on the Great Rip, one of the most extensive and dangerous of the Nantucket shoals.

A buoy-boat on the small shoal lying to the east of the northern end of the Bass Rip, (Nantucket shoals,) to mark the shoal itself, and indicate the passage between the Bass and Great Rip.

A spar-buoy on the sand-spit projecting from Fox's Point, (Nashawena island,) at the southern entrance into Quick's Hole.

Three small harbor or bug-lights, to facilitate the entrance into Holmes' Hole. The expediency and necessity of these additional aids for the protection of our commerce in this quarter, appear to me to be very obvious; and the many disasters and shipwrecks which occur annually from the want of them, I flatter myself will plead strongly in favor of their immediate adoption by our government. I have merely considered it necessary to allude to these additional aids to render navigation safe and easy, as Lieutenant Commanding C. H. McBlair has already very particularly recommended them to your notice—urging their useful effects by very cogent arguments, to which I can add nothing; but, concurring fully with him in his views, it will be necessary for me to refer you to his reports in relation to these matters, as an answer to this question, so far as my knowledge extends from actual observation. * * * * * * *

Very respectfully, your obedient servant,

S. SWARTWOUT,
Lieutenant Commanding.

Extracts from letter of Lieutenant Commanding J. N. Maffitt, U. S. navy, assistant in coast survey, in reply to above letter of the Superintendent, in relation to lights, beacons, and buoys needed on the coast of North and South Carolina—Sections IV and V.

U. S. Schooner Gallatin, *August* 10, 1851.

Sir: I have received your "circular" of the 20th ultimo, enclosing a copy of a letter from the secretary of the Light-house Board.
* * * * * * * * *

I propose three sets of bug-lights for Beaufort, N. C.—first, a single light, due north of the present channel buoy; second, a range light, for crossing the bar, or for the first course in; third, a range light on "Lower Bank," for the second course to anchorage. Two additional buoys are also required to mark out the channel.

A bug-light *is required* for the upper jettee of the Cape Fear river. There should be three spar-buoys in Charleston harbor, one at each end of the "Middle Ground," the other at "White Point," to define the end of that spit for the benefit of vessels bound up the Ashley.

A couple of beacons, for a range, should be erected near "Fort Johnson," as a guide for vessels to clear "Sumter Flats" and the end of the "Middle" when bound in and out of the South city channel.

To render South Edisto serviceable as a harbor of refuge, a second-order light should be placed on Seabrook Point, and three buoys in the channel-way.

Charleston light should be a "fixed light," with *improved reflectors.* No light should revolve—that is, one of a range for entering a narrow channel, as the loss of it, even for a few seconds, might be attended with danger.

I have frequently experienced the truth of this.

The beacon-light connected with the main light should be increased in brilliancy and shifted further south, to render the range complete for crossing in the best water. A railway for *this* beacon is required, as the bar is materially influenced by northeast storms, and the range consequently changing to southward.

The "Overall beacons" of Charleston harbor are useless, leading a vessel into six feet at low water. I propose that they be shifted to "Fort Sumter," as a range for the "Swash channel," one-eighth of a mile south of the "North," and with the same depth of water. This would enable coasting vessels and steamers that now use the "North channel" to enter the harbor at night by the "Swash."

A buoy is required on the southwest end of the Rattlesnake shoal.

The lights at Hatteras and Roman are *very poor;* both should be overhauled and furnished with *improved reflectors.*

Bell-boats would be of infinite service at the extreme point of Cape Lookout and the Frying Pan shoal.

The light-boat at Martin's Industry, South Carolina, should be furnished with *two* good lights, one forward and the other aft, of different elevations, that the boat may not be confounded with St. Helena light-boat. As the light-boat on "Martin's Industry" is old and unfit for its exposed and dangerous position, I propose that a new light-boat of great capacity, with an additional light, be placed on that shoal, and the present boat be moored off "Hilton Head," Georgia, to mark the point of "Grenadier shoal," which lies due north from "Tybee light." It is a dangerous spot, and a light-boat has repeatedly been called for by the Charleston and Savannah Steamboat Company.

* * * * * * *

I am, respectfully, your obedient servant,

JOHN N. MAFFITT,

Lieut. Commanding, and Assistant U. S. Coast Survey.

Extracts from letter of Lieutenant Commanding John Rodgers, United States navy, assistant in coast survey, in reply to foregoing letter of the Superintendent, in relation to lights, beacons, and buoys needed on the coast of Florida—Section VI.

United States Coast Survey Office,
Washington, August 25, 1851.

Sir: In reply to your letter of July 30, enclosing a circular from the Light-house Board, making inquiries in regard to the present condition of the lights and other aids to navigation which have come under my observation, I have the honor to say:

* * * * * * * * *

Additional lights are required on the Florida reef. The difficulties of navigation along this reef, arising from the curved shape of the channel, requiring continual change of course; the strength and irregularity of the current; the coral reefs which fringe either shore, and the lowness of the land, added to the vast amount of passing commerce, and the number and value of the wrecks, call for a full illumination. I think four more light-houses, and the shifting of a light-boat, would be sufficient.

I would place them thus: one about Alligator reef, off Indian key; one about Collins' Patches, off Key Vacas; one on Looe key; one half way between Cape Florida and Carysfort reef.

These should all be first-class refracting lights, or possibly, with the latest improvements, second class.

The light-boat now on Carysfort reef might have a proper lantern fitted to her, and be placed on the Rebecca shoals, between the Tortugas and Marquesas keys. The passage between the Tortugas and Marquesas keys is so much frequented by vessels bound into the Gulf of Mexico, as to call for a light-boat to point out the shoals in it.

With these lights, in addition to those now erected, or in progress, vessels could scarcely get on shore upon our side of the Florida channel without having been warned by a light.

With the increased safety there seem incidental advantages. Our shore being better lighted than the opposite one, vessels will keep in our own waters in passing through the Florida channel. The wrecks inevitable to extensive commerce will pay salvage to our citizens, rather than to foreigners; and foreign goods thus introduced, pay duties to our government.

The wrecks brought into Key West amount annually to about $1,200,000, and those on the Bahama Banks to twice as much.

It is a point with vessels coasting along the southern States to keep as far as practicable within the influence of the Gulf Stream, for time is of so much importance to them that they are willing to risk something to save time. Coasting steamers run from Cape Canaveral shoal to Jupiter inlet, where the trend of the land alters. A light-house would be useful as a point to run for, and to indicate when the change of course had become necessary. Such a light-house may perhaps be made to guard a shoal which lies between Jupiter inlet and Indian river, on which the United States mail steamer Georgia touched. Captain Coste, United States revenue marine, knows that such a shoal

exists. Captain Willey, a ship-owner and master, who has traded for many years along our southern coast, has furnished me with the following information: "Nine miles from land, ten miles E. by S. ½ S. from Indian river, lies a shoal about one mile long and two cable-lengths wide. It has five fathoms water on the north end, and fifteen feet on the south end; ten fathoms inside of it."

"SE. ½ S. from Indian river, and five miles from land, is another shoal with fifteen feet water on it."

"With Gilbert's bar bearing E. ½ N., distant four miles, is another shoal with five fathoms on it."

"A rock, with six or seven feet water on it, lies half a mile ESE. from the south side of Jupiter inlet: five fathoms close alongside of it."

The light-house can only be properly placed after an examination has been made.

A light-house would be useful about Hillsborough inlet, or where it shall be found that the first spur of the Florida reef starts from the main land.

In the distance of one hundred and seventy miles between Cape Canaveral and Cape Florida there is now no light. The two I propose should both, I think, be of the first class refracting lights, unless it should be found that the recent improvement in the second class make them nearly equal to the first.

"Improvements, if any, which particular lights may require, to render them equal to all the wants of commerce and navigation in their respective localities."

Over-estimate of distance, in consequence of dimness of the Tortugas light, is sometimes given as a cause of wreck. Its situation is one of the most important on our whole coast—nearly all the commerce of the Gulf of Mexico passes within sight of it. If additional force be needed to the requirement of a first-class light, it may be found in the military position of the Tortugas. To develop the full usefulness to commerce and the navy, of the extensive fortific tion now in progress there, as powerful a light as possible seems necessary.

Cape Florida has a good ordinary reflector light. Its position seems to point out as proper a first-class refracting one. I hope it will not be considered foreign to the subject of these lights for me to offer the suggestion, that the Florida channel is the natural outlet of the Mississippi; that the lights along the Florida reef are those in which the western planters of the United States are particularly interested; and that in lessening the danger of getting their produce to market, its price to them will be enhanced.

Cape Hatteras, Cape Lookout, and Cape Fear, seem all positions for first-class lights.

The light-house on Cape Fear is, according to Blunt's Coast Pilot, one hundred and ten feet above the level of the sea. Its range of visibility to an eye eleven feet above the sea, is, by calculation, 12.76 nautical miles. The Frying-pan shoals, off this cape, extend twenty miles from land. An inspection of the chart shows that these shoals should be illuminated. It does not seem practicable to give a tower on Smith island the height necessary to be seen so far. Light-boats are placed

in situations as exposed: it is possible that an examination might discover a sheltered berth for one.

In such situations it may be sound discretion to build screw-pile or other beacons, to be left some years to test their stability; when, if they stand the test satisfactorily, the light may be placed on the beacon and the boat removed.

The light at Cape Canaveral is not sufficient. The tower was built when it was believed that the shoals extended only three or four miles from the cape. Subsequent examination has discovered a shoal, with eight feet water on it, at the distance of eleven nautical miles.

* * * * * * * * *

Very respectfully, your obedient servant,

JOHN RODGERS,

Lieutenant U. S. N., and Assistant Coast Survey.

APPENDIX No. 17.

Table of light-houses, beacons, buoys, &c., recommended by chiefs of hydrographic parties of coast survey, for which no appropriations have been made.

Section.	State.	No.	Special localities.	Object recommended.	By whom examined.	Report of superintend'nt.
I	Maine	1	Thomas's reef, near Thom's ledge	Buoy	Lieut. Commanding Woodhull	Recomm'd July 28, 1851
		2	Light-house on Monhegan island	Fog-whistle	do ... do	Recomm'd July 28, 1851
		3	Light-house on Petit Menan island	do	do ... do	Recomm'd July 28, 1851
	Massachusetts	4	"Sow and Pigs" ledge, entrance to Buzzard's bay	Light-house	do ... McBlair	Recommended.
		5	Davis's new south shoal, Nantucket	Floating beacon	do ... do	Recommended.
		6	Great rip, Nantucket	Buoy-boat	do ... do	Recommended.
		7	Sand shoal near north end of Bass rip	do	do ... do	Recommended.
		8	Sand spit at south entrance into Quicks' hole	Spar-buoy	do ... do	Recommended.
		9	Long island, Boston harbor	Wooden beacons	do ... do	Recommended.
		10	Billingsgate shoal ...... Massachusett's bay.	Buoy-boat	do ... do	Recommended.
		11	South end of Billingsgate shoal .... do	Spar-buoys	do ... do	Recommended.
		12	Bibb rock, near Wellfleet harbor	do	do ... do	Recommended.
II	New York	13	Gedney's and Swash channel, entrance to New York harbor	Range-lights	Assistant J. B. Glück	Recommended.
IV	North Carolina	14	Beaufort harbor	do	Lieut. Commanding Maffitt	Recomm'd Feb. 27, 1851
		15	Beaufort harbor	Buoys	do ... do	Recomm'd Feb. 27, 1851
V	South Carolina	16	Middle Ground and White point, Charleston harbor	Spar-buoys	do ... do	Recommended.
		17	Near Fort Johnson, Charleston harbor	Beacons	do ... do	Recommended.
		18	Seabrook point, North Edisto harbor	Light-house	do ... do	Recommended.
		19	Channel way to .... do .... do	Buoys	do ... do	Recommended.
		20	Southwest end, Rattlesnake shoal	do	do ... do	Recommended.
VI	Florida	21	Rebecca shoal, between Marquesas and Tortugas	Beacon	Assistant F. H. Gerdes	Recommended.
		22	Reef near Sea-horse key	Buoy	do ... do	Recommended.
		23	Alligator reef, off Indian key	Light-house	Lieut. Commanding Rodgers	Recommended.

		24	Collin's patches, off Key Vacas	Light-house	Lieut. Commanding Rodgers	Recommended.
		25	Half way between Cape Florida and Carysfort reef	do	do do	Recommended.
		26	Near Jupiter inlet	do	do do	Recommended.
		27	Near Hillsborough inlet	do	do do	Recommended.
		28	Looe key	do	do do	Recommended.
*VIII	Alabama	29	Entrance to Mobile bay	Seven buoys	do Patterson	Recomm'd Aug. 20, 1849
		30	Entrance to Mobile bay	Five beacons	do do	Recomm'd Aug. 20, 1849
	Mississippi	31	Cat and Ship Island harbors	Nine buoys	do do	Recomm'd Aug. 20, 1849
IX	Texas	32	Aransas pass	Light-boat	do Craven	Recomm'd July 17, 1851
		33	Channel of Aransas pass	Buoys	do do	Recomm'd July 17, 1851
		34	Off Dollar point	do	do do	Recomm'd July 17, 1851
X	California	35	Rocks in harbor of San Francisco	do	do Alden	Recommended July 25
		36	Humboldt harbor, near North spit	Beacon	do do	Recommended.

*The beacons and buoys recommended by Lieutenant Commanding Patterson to be placed in this section (VIII) were noticed in the Annual Reports of 1849 and 1850. As they have not yet been acted on, they are again presented in this Report, (Appendix Nos. 35 and 36.)

APPENDIX No. 18.

Letter of Sears C. Walker, Esq., assistant in the United States coast survey, to the Superintendent, communicating an arrangement with the president of the Maine Telegraph Company, to determine the difference in longitude of Cambridge and Halifax.

CAMBRIDGE, MASS.,
September 23, 1851.

DEAR SIR: I enclose you a copy of the letter of H. O. Alden, esq., president of the Main Telegraph Company, to James Eddy, esq., the superintendent of the company. I would suggest that it should be noticed in your annual report to the Secretary of the Treasury.

You will see that I have negotiated for the Coast Survey to have the free use of the line from Cambridge to Calais after 9 p. m., we paying the operators for their time.

Fortunately, the superintendent (Mr. Eddy) was here to-day, in Boston, and I had a personal interview with the president, Mr. Alden, Mr. Eddy, superintendent, and Mr. Saddler, president of the Boston and Portland line. I have also conferred with Mr. J. C. Rowe, chief operator of the Vermont Chemical line, that goes to Cambridge. Mr. Eddy, Mr. Saddler, and Mr. Rowe, have a perfect understanding with each other. The line works now every night from Portland to Halifax. It will only require Mr. Saddler's battery. Add the distance from Cambridge to Portland. Mr. Bond will not need to have any battery except to work the local circuit—say of two cups.

These officers have no doubt of working any good night from Cambridge to Halifax. Mr. Eddy says there will be no need of sending an officer to Calais—he can do all through an operator. You see that so far as our post is concerned, everything is well arranged.

* * * * * * * * *

Yours truly,

SEARS C. WALKER.

Prof. A. D. BACHE, LL. D.,
Superintendent U. S. Coast Survey.

BOSTON, *September* 20, 1851.

DEAR SIR: Allow me to introduce to your acquaintance S. C. Walker, esq., who is an officer of the United States coast survey, and visits Bangor for scientific purposes. Mr. Walker wishes the use of our telegraph line from Portland to Calais, in connexion with the lines from Boston to Halifax, to enable him to make and communicate the results of astronomical observations, &c., &c.; all of which he will better explain to you.

There being no specific appropriation for such purposes, Mr. Walker, in behalf of science, asks the gratuitous use of our wires at night, and after business hours are closed; he paying such of our operators as are required to be employed by him, a reasonable compensation for their night service.

For the benefit of sciences this is, perhaps, one of those contributions which our company ought not to withhold; hence I have encouraged Mr. Walker, that we will not be behind our neighbors in according to him the privileges he asks. I have therefore referred him to you as fully authorized to act in the premises; and whatever you may do will receive my approbation.

Very truly, yours,

H. O. ALDEN,

President Maine Telegraph Company.

JAMES EDDY, Esq., *Bangor, Me.,*
Superintendent Maine Telegraph Company.

APPENDIX No. 19.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating the result of an examination by Lieutenant Commanding M. Woodhull, United States navy, into the necessity for certain aids to navigation on the coast of Maine, in accordance with act of Congress, and instructions of the Treasury Department.

COAST SURVEY STATION,
Mount Pleasant, July 28, 1851.

SIR: I have the honor to report that the examination into the necessity of a light-house at Narraguagus bay, (between Passamaquoddy bay and the Penobscot river, Maine,) and of buoys at the mouth of the Kennebec river, Maine, required by the act of March 3d, 1851, and the instructions of the department, has been made, and to present the following as the result:

The localities have been carefully examined by Lieutenant Commanding Maxwell Woodhull, who has presented all the information necessary to a correct conclusion in regard to the matters.

1. I agree with him in recommending a light-house on the southeastern point of Pond island, the light to be elevated not less than eighty feet above the line of high water, and to show a revolving light.

From Petit Menan island light, (on the outer seacoast,) Lieutenant Commanding Woodhull states: "The point of Pond island can be distinctly seen, the range bearing NNE., and gives the course to Pond island. After passing this point, a course due north takes the navigator directly to the mouth of the Narraguagus river, with the light always in sight if in deep water, but shut in if he encroaches too much on the ledges and middle ground, on either side of it."

The light should be erected near the southeastern extremity of the point. It should be, as recommended by Lieutenant Commanding Woodhull, of the class of smaller seacoast lights, (third order of lens lights,) elevated sufficiently to show three miles to the seaward of Petit Menan island light, and revolving, to distinguish it from the sea-coast lights on either side of it.

The intervals between the full brilliancy of the light and its disappearance should not be greater than a minute.

Lieutenant Commanding Woodhull gives the following facts as

bearing upon the usefulness of the light at Pond island, considered as a local light, to which class it essentially belongs:

"Besides the Narraguagus river, there are two others emptying into Narraguagus bay—Mill river, with the town of Huntingdon at its mouth, and East Marsh river. The trade of the towns of Cherryfield and Millbridge, on the Narraguagus river, is very large; last year they had 400 coasters and other vessels visit them, and receive cargoes. Their trade yearly amounts to 30,000,000 feet of sawed timber, with about 15,000,000 of manufactured lathes. For Huntingdon and "East Marsh," I have been informed, their trade is about half that amount. On these rivers, besides the lumber trade, a great number of vessels of various classes are built yearly."

2. I concur also with Lieutenant Commanding Woodhull in recommending that the buoys for White's and Thom's ledges, and Pond Island reef, at the mouth of the Kennebec, appropriated for in the act of March 3d, 1851, be immediately placed.

3. Lieutenant Commanding Woodhull further recommends a fog-whistle to be placed at the light-house at Petit Menan island, (off Narraguagus bay,) and at Monhegan island, (off Penobscot bay,) and remarks upon the inefficiency of the fog-bell at the latter place.

Also a buoy on Thomas' reef, near Thom's ledge, which he considers as imperfect as the other buoys reported upon, and which he states can, with the others, be placed for the sum appropriated for the three mentioned in the act.

"The trade of the different rivers that empty into Penobscot bay is conjointly estimated at about 3,000 vessels yearly, and an average of from three to four steamers daily, eight months of the year. Monhegan light is the entrance light to this bay."

In these recommendations I concur.

Lieutenant Commanding Woodhull states, that in the opinion of many intelligent navigators on this coast, the lights on "Goose island," (Penobscot bay,) and on Bear island, (Mount Desert,) should be discontinued, as not merely useless, but dangerous to navigation; in which opinion he concurs.

Very respectfully yours,

A. D. BACHE,
Superintendent United States Coast Survey.

Hon. W. L. Hodge,
Secretary of the Treasury.

APPENDIX No 20.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating, with his approval, the recommendation of Lieutenant Commanding M. Woodhull, United States navy, assistant in the coast survey, to place a light-boat on Shovelful shoals.

Ossipee Station, near Alfred, Maine,
September 1, 1851.

Sir: In compliance with the provisions of the act of March 3, 1851, and the instructions of the department, I have the honor to report that

the examination of the necessity for a light-boat at "Shovelful shoals," near Chatham, Massachusetts, has been made, and to recommend that a vessel of suitable size, and showing an effective light, should be placed on the southeast extremity of the shoal. I enclose herewith the report of Lieut. Commanding Maxwell Woodhull, United States navy, assistant coast survey, by whom this examination has been made, under my direction, and the sketch which accompanied it, illustrating the points referred to in the report.

Very respectfully yours,

A. D. BACHE,
Superintendent U. S. Coast Survey.

Hon. Thomas Corwin,
Secretary of the Treasury.

United States Schooner Madison,
Woods' Hole, August 24, 1851.

Sir: Agreeably to your order, I have examined all the particulars concerning the proposed light-boat on "Shovelful shoals," and am convinced, from my own observation and the opinions of the several pilots and masters of vessels with whom I have conferred on the subject, that a light-boat has long been needed on this shoal, and I therefore recommend its being placed there as soon as possible.

It should be placed on the southeast extremity of the shoal, that being the point where all the courses meet, whether coming from the *northward*, or from the north, middle, or southern channels of Vineyard sound. It would be a guide to clear the "Handkerchief," the "Stone Horse," and "Pollock Rip," and make the passage of "Butler's Hole" always serviceable, while it is now only useful in day-light. It would shorten the run to vessels making a harbor in the "Powder Hole" nineteen miles. If the weather is threatening and foggy, vessels now making the anchorage under the cape have to go round the "Pollock Rip" and the "Great Round Shoal," then run to the westward of the "Handkerchief," thereby lengthening the distance, and consequently increasing the danger; when, if the light-boat were on the "Shovelful," the passage between the shoals would be comparatively safe navigation.

I would recommend, in conjunction with this subject, as a new boat is to be built, and the appropriation is abundantly sufficient for the purpose, that it be of larger dimensions, of an improved construction, with a more powerful light, when ready, to be placed on "Pollock Rip," and the one now stationed there be transferred to the "Shovelful," where it would answer every purpose and be more useful than where it now is. The boat on "Pollock Rip" is too small for the purpose; it is a general complaint that during a blow the light cannot be hoisted sufficiently above the deck to be a certain guide, and in some instances could not be lighted, owing to the motion of the vessel throwing the oil from the lamps. I think a light-boat should be of sufficient capacity to carry the light at all times at the usual elevation, or it becomes of little or no service.

I send you a sketch of the locality, with the different shoals, placed agreeably to their relative positions, with the several *courses* laid down, showing where they converge, which will express the necessities of the case better than I can otherwise describe them.

Very respectfully,

MAXWELL WOODHULL,

Lieut. Commanding U. S. N., Assistant Coast Survey.

Prof. A. D. Bache,

Superintendent U. S. Coast Survey, Washington.

APPENDIX No. 21.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating a report of Lieutenant Commanding C. H. McBlair, United States navy, assistant in the coast survey, on the erection of "bug" or harbor lights at Holmes' Hole, Martha's Vineyard.

Coast Survey Station,

Near Portland, Maine, July 19, 1851.

Sir: I have the honor to report that the examination into the necessity for the erection of a light-house at Holmes' Hole, Martha's Vineyard, Massachusetts, has been made, as required by the act of Congress of March 3, 1851, and the instructions of the department. I communicate herewith the detailed report of Lieutenant Commanding Charles H. McBlair, United States navy, assistant in the coast survey, the officer by whom the examination was made under my direction.

I would further respectfully report, that, instead of the light-house at Holmes' Hole, for which an appropriation has been made, three small beacon-lights, technically known at that port as "bug lights," should be placed in the position shown on the accompanying Coast Survey chart, recommended by Lieutenant Commanding McBlair. For reasons stated in his report, these lights should be of the smallest class of *beacon*-lights used in harbors, on low wooden structures, the height being regulated by the elevation of the ground and the relation to surrounding objects. I would recommend that the light nearest the water should be red, and that all should be so screened as not to show, except on a moderately large sector, east side of the range line, which they are expected to give.

Three "bug lights," or beacons, can probably be put up within the appropriation made by the act of Congress; and it is a question for the department to decide, whether its authority extends to their immediate erection, or whether the subject must be referred to Congress, under the act of March 3d, 1851.

Very respectfully yours,

A. D. BACHE,

Superintendent United States Coast Survey.

Hon. W. L. Hodge,

Acting Secretary of the Treasury.

U. S. Surveying Steamer Bibb,
Nantucket Bar, July 16, 1851.

Sir: In obedience to your instructions, I have carefully examined Holmes' Hole harbor, for the purpose of ascertaining what additional lights are necessary, and the most suitable locations for them.

I would respectfully recommend the establishment of three harbor lights of the smallest class, to be placed on the sites indicated by the accompanying sketch. The houses might be frame structures, similar to those erected for the small lights called bug lights of this port. Buildings of this description would be most economical, and answer every purpose. They would be placed in such immediate vicinity to the village, that a dwelling for the keeper may not be necessary.

It is not important that the lights themselves should be visible over four miles. The greatest danger encountered in entering this harbor proceeds from the rocks and shoals lying near Low Point. The skirt of wood occupying the higher ground, at some distance from the beach, is sometimes mistaken at night for the shore line, leading vessels to double Low Point too closely to clear the shoal or rocks. Frequent disasters arise from this circumstance.

The lights placed as proposed, furnish two well-defined ranges, the object of one of which is to guard against this danger, while the other shows the mid-channel and best water along the entire harbor.

Holmes' Hole is used as a port of refuge by vessels navigating the sound, on occasion of head winds and tides and storms; and the adoption of these or similar improvements would add security to life and property.

If the lights suggested are established, it will be necessary to modify the present sailing directions. I have prepared the following, and present them to you in full at the present time, as the best means of exhibiting the value of the ranges referred to.

Entering this harbor from the westward, east chop well open with west chop light-house, clears you of the middle ground. Give west chop a berth of half a mile, until you bring on the western range of the harbor lights, when, with the chart for your guide, bear up for your anchorage in the outer roads. If you want to stand into the inner harbor, bring on the eastern range of the harbor lights, and follow it.

Approaching from the eastward, give east chop a berth of half a mile, and bring on the eastern range of the harbor lights; following which, you may cast anchor either in the outer or inner harbor.

Ships may anchor in three and a half fathoms, muddy bottom; west chop light just open, with woods on Low Point.

Small vessels may anchor immediately off the town.

You can beat in with safety, the shores being bold and clear. West chop light is fixed, elevated sixty feet above the level of the sea, and visible sixteen miles.

Respectfully,

C. H. McBLAIR,
Assistant Coast Survey.

Prof. A. D. Bache,
Superintendent U. S. Coast Survey, Portland, Maine.

APPENDIX No. 22.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, recommending certain aids to navigation required by act of Congress and instructions of the Treasury Department.

COAST SURVEY OFFICE, *April* 29, 1851.

SIR: I have the honor to report upon the following objects referred to this office, embraced in the act of Congress making appropriations for light-houses, light-boats, beacons, and buoys, approved March 3, 1851:

No. 4. The eleven buoys in the channel to Commercial Point and Neponsett river, in Dorchester, are recommended, accompanied by a special report to me from Lieutenant Commanding Charles H. McBlair, United States navy, assistant coast survey, a copy of which accompanies this report, and a sketch showing a survey of the locality, from this office.

No. 6. A beacon on Fawn bar, near Deer island, is recommended. For detailed opinions see special report from Lieutenant Charles H. McBlair, United States navy, assistant coast survey; also with a sketch of the locality.

No. 7. The two iron spindles on the northeast ledge of the Graves, and on Harding's ledges, Boston harbor, are recommended. The special report of Lieutenant Charles H. McBlair, and accompanying sketch, may be referred to for detail.

No. 8. The proposed light-boat off Brenton's reef, Narragansett bay, is deemed of great importance. A sketch accompanies the special report of Lieutenant McBlair, which will show the proper position for it.

No. 14. The four spar-buoys for Fire Island inlet, Long Island, were recommended by this office, and are considered of the highest importance to the coasting trade of Great South bay.

No. 16. The light-house on Bodkin shoal, intended as a substitute for the one now on the Bodkin Point, is considered of much importance. A chart of the Patapsco river, with the proper position for the tower marked upon it, accompanies this report.

No. 19. The buoy for Middle Ground shoals, Beaufort harbor, North Carolina, was recommended by this office. Its proper position will be seen by reference to the accompanying sketch of Beaufort harbor.

Nos. 22 and 23. The buoy for Diamond shoal, Cape Hatteras, and the floating bell-beacon for the outer shoal, Cape Hatteras, were recommended by this office. The recommendation, accompanied by drawings and estimates, was submitted to the department for its approval.

No. 24. The light on the "Upper jettee," Cape Fear river, and the bridge leading to it, were understood, from a communication from the Fifth Auditor, to be included among the objects of appropriation referred to this office. A personal examination was made of the locality, which produced considerable doubt as to the necessity for the expenditure. Subsequent to the personal examination referred to, the Fifth Auditor advises me that this is one of the objects which he does not desire to

be examined by this office. It is deemed proper to say that it would be well to examine into this subject before the work is commenced.

No. 27. The light-houses authorized for Capes Disappointment and Flattery, and for New Dungeness, Oregon, have been recommended by this office, and are considered of the highest importance to the commerce of the northwest coast. The position on Cape Disappointment for the light will be marked in the Coast Survey chart of the Columbia river.

The light on New Dungeness should be placed near the extremity of the point, about 2¼ miles from the main land. As this is a very low point, not visible at night, it will require a tower of about eighty feet in height.

The light for Cape Flattery should be placed on Tatooche island, a small island almost touching the northwest extremity of Cape Flattery. The light is considered of great importance, as it will enable navigators to enter the straits at night, which they cannot do now.

The four spar-buoys for Fire Island inlet, the buoy for Middle Ground shoal, North Carolina, and the buoy and bell-beacon for Hatteras shoals, having been recommended by this office, I have to request authority to purchase by contract, under the regulations of the department, and place them in their respective positions. We can also conveniently place those in the Neponset river, if desired by the department.

An abstract of the subjects referred to this office, in this connexion, is herewith sent. The objects referred to this office, not reported upon, require personal examination, which is now being made. So soon as the reports are received, the department shall be informed of the result.

The sketches and special reports accompanying this are numbered according to the paragraphs in this letter referring to them. A general abstract showing all the objects for which appropriations have been made, and the disposition of the several subjects at this date, is herewith submitted.

Very respectfully, yours,

A. D. BACHE,
Superintendent U. S. Coast Survey.

Hon. W. L. Hodge,
Acting Secretary of the Treasury.

Reports of Lieutenant Commanding McBlair, United States navy, assistant in coast survey, to the Superintendent, on certain aids to navigation in Boston harbor, &c.

Coast Survey Office,
Washington, April 23, 1851.

Sir: I respectfully submit the following report, accompanied by sketches of the localities, on the subject of the improvements for the navigation of coast, referred to in your letter of instructions.

The objects proposed stand in the following order:

1. "Eleven buoys in the channel to Commercial Point and Neponset river, in Dorchester."

2. "A light-house at the head of Holmes' Hole harbor."

3. "A beacon on Fawn bar, near Deer island, Boston harbor."

4. "Two iron spindles on northeast ledge of the Graves and Harding's ledge, Boston harbor."

5. "A light-boat off Brenton's reef, Narragansett bay."

a. "Eleven buoys in the channel to Commercial Point and Neponsett river, in Dorchester."

A full report on this subject has been already laid before you in my letters of March 1, and February 22, 1851, copies of which I herewith enclose. It is only necessary to add that the buoys recommended have no other than local value.

b. "A light-house at the head of Holmes' Hole harbor."

Further examination, which can be conveniently made during the approaching season, will better enable me to report on this point.

c. "A beacon on Fawn bar, near Deer island, Boston harbor."

d. "Two iron spindles on the northeast ledge of the Graves and Harding's ledge, Boston harbor."

The northeast ledge of the Graves and Harding's ledge, as the outposts of the obstructions strewing the approaches to Boston, should be conspicuously marked, and spindles surmounted by cones of different colors would answer this purpose. Harding's ledge especially, now a danger in itself, and but imperfectly marked by a buoy, if distinguished by a spindle, would serve a valuable auxiliary guide in the approaches to the main ship channel.

The northeast ledge of the Graves, similarly marked, would answer the same end with respect to the neighboring Hypocrite and the Broad Sound channels.

In connexion with the spindle on the northeast Graves ledge, a beacon on Fawn bar would be serviceable as a good intervening mark between that ledge and the Deer Island beacon. Vessels using the Broad Sound and Hypocrite channels would thus be guided by a succession of distinct marks, each becoming visible in its turn before the one passed is entirely lost.

The particular advantage of a beacon on Fawn bar would be the facility it would give to the navigation of the Broad Sound north channel; the buoy now moored on the bar, to further this end, could then be advantageously shifted to the narrowest part of that channel on the western side.

e. "A light-boat off Brenton's reef, Narragansett bay."

The establishment of a light-boat here is of great importance. It would mark a dangerous shoal, and, in connexion with the Beaver Tail light, clearly define the entrance through the eastern channel into the harbor of Newport, Rhode Island.

I am of opinion that all the foregoing improvements would conduce largely to convenience and safety in the navigation of the respective waters where it is proposed to introduce them. Their value would be purely of a local kind, and they would have no other connexion with existing marks or lights than what has been pointed out.

Respectfully,

C. H. McBLAIR,
Assistant Coast Survey.

Professor A. D. Bache.

COAST SURVEY OFFICE,
Washington, February 22, 1851.

DEAR SIR: From an examination of the chart showing the approaches to Dorchester, it would seem necessary for the safe navigation of those waters, which affects a large and increasing amount of tonnage, that eleven buoys, painted according to regulation, should be planted, viz: six to designate the channel to Commercial wharf, and the remaining five as guides to Neponset village. They must be distributed as follows: one on the west side of the channel opposite to Farm School, on Thompson's island, two on Cow Pasture bar, two on Term bar, and one opposite Commercial wharf.

The Neponset river would require one between Commercial wharf and Pine Neck, three along the curvature the river forms about Pine Neck, and one off the wharf at Neponset.

Respectfully,

C. H. McBLAIR,
Lieut. Commanding U. S. N., Assistant Coast Survey.

Prof. A. D. BACHE.
Superintendent Coast Survey.

COAST SURVEY OFFICE,
Washington, March 1, 1851.

SIR: Lieut. Com. Charles Davis, to whom was referred my letter respecting the buoying of the channel near Dorchester, suggests that the outer buoys spoken of in that communication should be of the usual harbor size, while the inner ones, and especially the river buoys, might be much smaller and less expensive.

I am, respectfully,

C. H. McBLAIR,
Lieut. Com. U. S. N., Assistant U. S. Coast Survey.

Prof. A. D. BACHE,
Superintendent Coast Survey.

APPENDIX No. 23.

Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, on ranges in New York harbor; with extracts from the report of assistant J. B. Gl ck.

COAST SURVEY OFFICE,
November 29, 1851.

SIR: An examination made of Flynn's Knoll, New York harbor, with the members of the Light-house Board, induced a doubt in my mind whether the light-house proposed to be erected there was the best aid to navigation which could be suggested; and, indeed, whether it might not alter injuriously the present régime of the harbor. The

inquiries of the Light-house Board were directed to the same points, and their conclusions will, therefore, also be before the department.

It occurred to me that a system of range-beacons could be used for passing Sandy Hook by the main ship channel, and for passing through the Swash channel, which would answer all the purposes of the proposed light on Flynn's Knoll, without being attended with any risk of causing new deposites on the bar, and which could be put up and maintained at a very small expense. I have accordingly caused minute surveys to be made of the shore near the probable sites of these beacons, and transmit, herewith, the sketches and report returned by assistant J. B. Glück, of the coast survey, and also a Coast Survey chart of New York bay and harbor, marking these and other sites on which range-lights may be established, to answer the purpose referred to above.

I would recommend two range-lights (beacon) to lead from the point G, in Gedney's channel, through the main ship channel, to the range of the beacons recommended in the sailing line H N through the Narrows; the beacons to be on the line G D or G M in the angle between them, as may be found most expedient, on an examination which should be made just previous to their location. The distance A D is rather small for the range, being less than one-ninth of G A. A beacon near L will furnish also other important ranges.

Also, two leading lights (beacon lights) for the Swash channel, nearly on the line S E. Before placing these lights the Swash channel should be carefully re-surveyed, which can be done at a very trifling expense by the Coast Survey, by using existing marks on the shore already determined in the survey, as there is an impression among the pilots that it is deepening. The beacons should be placed accordingly.

These lights should be so arranged that they will appear nearly in one when heading on the sailing lines They should be distant from each other not less than about one mile and a half, or one-sixth of the distance from which they are first required to give the range. They should be carefully screened, so as only to show a light on the range or ranges which they are to indicate; and for distinction from each other, as they are only required to show some nine miles, the one near the Elm-tree beacon may be a red light, (deep red.)

Yours, respectfully,

A. D. BACHE,
Superintendent United States Coast Survey.

Hon. THOMAS CORWIN,
Secretary of the Treasury.

Extracts from a report on ranges in New York bay, to Superintendent, by J. B. Glück, esq., assistant in coast survey.

UNITED STATES REVENUE CUTTER TANEY,
Brooklyn, New York, July 13, 1851.

DEAR SIR: I have just returned from surveying the two ranges for entering Swash and main channels of New York bay, in accordance with your instructions of July 1.

The range for entering Swash channel, of which Elm-tree beacon forms one part, affords unusual facilities, as it strikes over the narrow brows of three elevations of one and a half, ($1\frac{1}{2}$) one and three-quarters, ($1\frac{3}{4}$) and two miles distance from the beacon; being, respectively, sixty, (60) eighty, (80) and one hundred and sixty, (160) feet high. That of sixty is bare; that of eighty is covered with trees and thick brushwood from twenty to twenty-five feet high; and the one of one hundred and sixty with forest trees from sixty to seventy-five feet high. These three sites are upon the estate of Mr. George Ebbitt, New Dorp, Staten Island.

The range for coming through main ship channel touches the shore nearly a mile eastward of Point Comfort, through a very depressed part of the beach; the sand-banks on either side (from ten to twelve feet high) sinking nearly to the level of high-water mark. About three hundred metres back from the beach, the range strikes a swamp thickly covered with trees from fifteen to forty feet high; from thence it runs mostly through woodlands—occasionally through settlements and clearings. About a mile inland from the beach, the range crosses the creek and marsh making into the westward of Point Comfort. Upon the whole line surveyed there is no point that reaches an elevation of twenty feet, and, as I am informed, there is none for five miles further back, to the hills near Middletown. From the terminus of my survey, I could see back nearly another mile, but no higher elevation on that extension could be gained; I therefore confined the survey to the limits formed by the creek, on the banks of which the hills are slightly the highest. On this range both lights could be screened by trees, so as to be invisible to seaward, except on the range itself.

I am much indebted to Captain Rudolph, commanding United States revenue schooner Taney, and his officers, for their kindness in aiding the survey, and extending every facility possible for its accomplishment.

* * * * * * * * *

I send herewith the maps of New York bay, upon which I have marked the two ranges as directed.

The front light on Point Comfort range, for coming through main channel, might be placed at either A or B. The light would probably be sufficiently screened at A from being seen at sea, by the clump of trees about one hundred metres to the southeast, or by the woods on Sandy Hook, until the vessel is on the range itself. At B this purpose would be fully achieved.

The back light on this range might be properly placed at either C or D. The ground at D is several feet higher than at C, and therefore preferable. But little cutting is required to clear this whole range.

On the range for entering through Swash channel, where Elm-tree beacon now stands, will be the place for the front light. The breakwater should be moved to the west of the beacon instead of to the eastward, as this structure, in its present position, only serves to undermine the beacon, for the protection of which it was built. Complaints are made in regard to the color, which is red; at a distance of about two miles off shore I found it to be scarcely visible.

There are four points on this range where the back light might be

located, although C is, in my opinion, the most desirable site for it, being on an elevation of eighty feet, covered with trees and bushes, high enough to screen the light from either side. The sites A and B are bare, and, respectively, twenty and sixty feet high. That at D is from one hundred and forty to one hundred and sixty feet high. The thick and almost inaccessible forest makes it difficult to give a true delineation of the ground, or an accurate value of its elevation.

A black and white flag is fastened to the highest tree on the range, and the tree determined.

Trusting that I have executed this work to your satisfaction, I am, most respectfully, your obedient servant,

JOHN B. GLUCK,
Assistant in Coast Survey.

Prof. A. D. Bache, LL. D.,
Superintendent United States Coast Survey,
Mount Pleasant, Maine.

APPENDIX No. 24.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, recommending certain aids to navigation on the coast of New York and New Jersey, required by act of Congress and instructions of the Treasury Department, and communicating the report of Lieutenants Commanding Jenkins and Woodhull, U. S. N., upon the same.

Coast Survey Office,
June 13, 1851.

Sir: In compliance with the act of Congress of March 3, 1851, and with the instructions of the department of April 2d, I have the honor to report on the buoys, beacons, fog-bell, and light-house, numbered 9, 11, 12, 13, 17, 18, in the tabular statement of light-houses, beacons, and buoys, for which appropriations were made in the act just referred to. A copy of the tabular statement is annexed, with the additional remarks now submitted. The details of the recommendations are given in the report of Lieutenants Commanding Jenkins and Woodhull, herewith submitted, and the localities are marked in the Coast Survey charts A, B^1, B^2, C, D, and E, hereto appended.

No. 9. The buoy on Peafield reef, off Black Rock harbor, is recommended; also an additional buoy, for which, however, no appropriation has yet been made.

No. 11. The light-house on the north point of Gardiner's island is recommended, showing a red light. For the consideration inducing this recommendation, I refer to the report of Lieutenants Commanding Jenkins and Woodhull.

No. 12. The beacon in Sag harbor is recommended.

No. 13. The two beacons near Fort Hamilton are recommended. It is understood from the Chief Engineer, General Totten, that there will be no objection made to a temporary structure on the glacis of the redoubt of Fort Hamilton, in the locality marked on the chart.

No. 17. A fog-bell for Newark light-house is recommended.

No. 18. The four buoys in the Passaic river, and the one on Mill Rock, were found by the officers sent to make examination, to have been already placed, under authority from the Fifth Auditor.

b. The beacon recommended to be constructed, and the buoy now occupying its site should be removed to the three-feet sand-knoll south and east of Newark light.

c. The beacon at the corner stake, near Elizabeth Point, is recommended. For details relating to its construction, I refer to the report of Lieutenants Commanding Jenkins and Woodhull, herewith submitted.

Very respectfully, yours, &c.,

A. D. BACHE,

Superintendent U. S. Coast Survey.

Hon. THOMAS CORWIN,

Secretary of the Treasury.

Report of Lieutenants Commanding Jenkins and Woodhull, U. S. N., and assistants in coast survey, to the Superintendent, upon the necessity for placing certain aids to navigation, required by act of Congress and instructions of the Treasury Department.

U. S. SURVEYING SCHOONER MADISON,

Sag Harbor, May 14, 1851.

SIR: In compliance with your instructions of the 29th instant, we made a careful personal examination of the places enumerated, with reference to placing the proposed aids to navigation, in conformity to the 3d section of the act making appropriations for light-houses, light-boats, beacons, and buoys, approved March 3d, 1851, and submit the following report:

Two buoys should be placed on Peafield reef, off Black Rock harbor, as marked on the accompanying harbor chart. We recommend that the one authorized by law be placed on the S. (+) point of the shoal.

The contiguity of Plumb island and Little Gull island lights to the north point of Gardiner's island rendered the necessity for a light at that place somewhat doubtful; but upon a careful consideration and examination of the subject, we are satisfied it will be a very important aid to navigation. For coasters bound to Sag Harbor, Green Port, and other places in the vicinity from the eastward, it is very necessary, owing to the great length and little elevation of the point. To vessels from over-sea voyages it is important to guide them into a safe and commodious harbor of refuge. The tower should be placed as near the extremity of the north point as may be practicable, with reference to a good foundation, and the light should differ from the two nearest to it—(Plumb island and Little Gull island.) A bright red light would probably be the most suitable for the purpose.

We recommend that the beacon authorized to be placed in Sag harbor may be erected on the shoalest part of the southwest point of the sand-spit. We consider this beacon an important aid to the navigation of Sag

harbor, and that it should be constructed with sufficient stability to resist the ice when it breaks up in the spring.

The two beacons to be placed near Fort Hamilton are important: they should be placed upon the continuation of the sailing line, as represented on the Coast Survey chart, from near southwest spit up mid channel, to serve as leading marks by night as well as by day. The southern beacon should be placed near the fish-house, and the northern one near the redoubt. It is believed that a proper position may be found for the northern one on the public land, without interfering with other interests. One keeper could attend to these two beacons, provided his dwelling is placed contiguous to them. (See Coast Survey chart accompanying this report.)

A fog-bell is necessary for the Newark light-house.

A buoy on Mill Rock, (Constable's Point,) and four buoys to mark the channel of the Passaic, have been found already placed. The accompanying Coast Survey chart will exhibit the approximate positions of the buoys. The can-buoy on this sketch is a short distance to the eastward of the position for the beacon authorized to be erected, which we consider to be important, and recommend that it be built on three wooden piles, driven at the angles of a triangle, with the proper inclination to form a pyramidical structure when boarded up.

We recommend that the buoy now occupying the position of the beacon may be placed on the three-feet sand-knoll, to the southward and eastward of the Newark light, when the beacon shall be completed.

The proposed beacon to be placed at the corner stake, near Elizabethtown Point, is an important and very necessary aid to navigation. We recommend that it should be built in the same manner described for the one at the mouth of the Passaic.

The piles for this and the Passaic beacon should be coppered a sufficient distance above and below the water, to prevent the ice from injuring them; any solid structure would injure the channels.

Very respectfully, yours,

THORNTON A. JENKINS,
Lieutenant U. S. Navy, Assistant U. S. Coast Survey.

M. WOODHULL,
Lieut. Com. U. S. Navy, Assistant Coast Survey.

Prof. A. D. Bache,
Superintendent U. S. Coast Survey.

APPENDIX No. 25.

Report of Sears C. Walker, assistant in the coast survey, communicating the measures of wave-time made from 1849 *to* 1851.

Cambridge, *September* 30, 1851.

Dear Sir: I beg to submit a statement of the experience of the Coast Survey on the subject of galvanic wave-time, since my last annual report of October 15th, 1850.

The result of our experience was then stated, as follows:

1. That the average of all our experiments to that time indicates a velocity of propagation of the inducing waves of 15,400 miles per second in the iron wires of a telegraph line.

2. That the velocity of propagation through the ground appears to be less than two-thirds of the volocity in the iron wires.

These conclusions were in accordance with the independent results of the researches of Dr. B. A. Gould and Mr. Karl Culman, previously read, and since published in the proceedings of the American Association for the Advancement of Science, at their meeting at New Haven, in August, 1850.

There have been three independent series of observations for the value of wave-time, made since October last, 1850.

The first experiment was repeated on several nights, between Seaton station and Portsmouth, Va. The distance on the iron wires is 268 miles, and the distance through the ground is 180 miles. The clock station excess, in the electrotonic readings, by a mean of 221 measures, was +0*s*.024, while the computed excess for the assumed velocity of 15,400 miles per second, in the iron wires, was +0*s*.035. The difference between theory and computation is, theory greater by +0*s*.011.

The second experiment was made from Charleston, S. C., to Augusta, Ga., in the winter of 1851. The distance on the iron wire from Columbia (where the Charleston end went to the ground) to Augusta, was 301 miles, and from Augusta to Savannah 146 miles—making the total connexion through the iron wire 447 miles, and the distance through the ground, from Columbia to Savannah, 135 miles. The clock was at Savannah. The arbitrary signals were given at Charleston. The observed clock excess was by 59 measures +0*s*.056. The computed wave-time, for the above assumed velocity, was +0*s*.058, leaving a difference of +0*s*.002.

The clock excess of Augusta above Savannah was, by observation, (forty measures,) +0*s*.019; by theory, +0*s*.019; difference +0*s*.000.

The third experiment was made at Cincinnati, on the 9th of May last, on the occasion of the meeting of the American Association for the Advancement of Science. The telegraph line was composed of 840 miles of iron wire, without ground connexion. The distances were as follows: From Cincinnati to Steubenville 295 miles; thence to Cincinnati the same; thence to Louisville 125 miles; thence to Cincinnati the same. The personal clock signals were given by Mr. Stager, chief operator at Cincinnati. In the first experiment the arbitrary signals were given by the operator at Steubenville, and recorded at Steubenville, and also on the two registers at Cincinnati, on opposite branches of the line. These registers I will call, respectively, Stager and Jones; Stager being the register for the clock station. The observed excesses were, for the Steubenville arbitrary signals, as follows:

Stager—Steubenville.......................+0*s*.040 by 31 measures.
Stager—Jones ....+0*s*.039 by 31 "

Again, for the Jones arbitrary signals, on the Stager clock scale, we found:

Stager—Steubenville.......................−0*s*.004 by 39 measures.
Stager—Jones ....+0*s*.050 by 226 "

The direction of the current from the platinum to the zinc, through the junction wires, was from Stager to Steubenville; thence to Jones; thence round by Louisville to Stager.

This is the first experiment made by the Coast Survey on a telegraph line of iron wire exclusively, without ground connexion.

The first conclusion to be drawn from this experiment is, that the excesses of the clock station readings, in the experiments heretofore made, have not been owing to the fact that a part of the galvanic circuit has been made through the ground, since they are here found to be as great for the dimensions of the line as in former experiments, with the partial ground connexions.

This experiment was made with a long circuit of iron wire, without ground connexion. It confirms the general conclusion respecting the value of wave-time.

It gives a new field for the discussion of the physical question whether the wave is propagated round in one direction, and only affects the magnets as it reaches them in succession in this direction, or whether the wave travels by the *shortest* direction from one magnet to another, without reference to the character of the poles.

Our experiments with lines composed partly of ground and partly of iron wire stretched on poles, led to the preference of the latter view of the subject.

The experiment at Cincinnati, in 1851, raises some doubt on this conclusion. It was made with a single battery at Cincinnati, and with 840 miles of wire, all in the air. The work of this night was not as complete as I could have desired. I must, therefore, wait till similar experiments are made, under more favorable circumstances, before attempting a further examination of the question.

No.	Date.	Clock station.	Signal station.	Name of excess.	Miles of wave space.	Observed wave time.	No. of measures.	Obs'd—comp'd wave time.
						s.		s.
1	January 23, 1849	Pa ..	Ca...	Pa—Ca	938	+0.063	25	+0.002
2	....do...... do..	..do..	..do..	.do—N	418	.024	16	+0.003
3	....do...... do..	..do..	..do..	Wn—Ca ...	938	.053	34	+0.008
4	....do...... do..	..do..	..do..	.do—N	418	.011	23	+0.016
5	....do...... do..	..do..	..do..	N—Ca	520	.039	18	—0.005
6	....do...... do..	..do..	N...	Pa—N	418	.036	7	—0.009
7	....do...... do..	..do..	..do..	.do—Ca	418	.004	8	+0.023
8	....do...... do..	..do..	..do..	Wn—Ca ...	418	.034	9	—0.007
9	.... do......do..	..do..	..do..	Wn—N	418	.020	14	+0.007
10	October 31 1849	Ci...	Wn..	Ci—Wn....	1,151	.068	88	—0.008
11	....do...... do..	..do..	..do..	.do—Cd	651	.043	12	—0.001
12	....do...... do..	Wn..	Cd ..	Wn—Ci....	330	.019	34	—0.002
13	....do...... do..	..do..	..do..	.do—Ci	330	.023	29	+0.002
14	....do...... do..	..do..	..do..	H—Cd.....	182	.008	22	+0.004
15	....do...... do..	..do..	..do..	.do—Ci	182	.009	25	+0.003
16	....do...... do..	..do..	Wg..	Wn—Cd ...	330	.017	17	+0.004
17	....do...... do..	..do..	..do..	.do—Ci	618	.025	12	+0.015
18	....do...... do..	..do..	..do..	H—Cd.....	182	.038	5	—0.026
19	....do...... do..	..do..	..do..	.do—Ci	470	.043	9	—0.013
20	....do...... do..	..do..	..do..	Cd—Ci	288	.004	12	+0.015
21	February 4, 1850	..do..	Pg ..	Wn—Pg ...	576	.028	41	+0.009
22	....do...... do..	..do..	..do..	.do—do	576	.030	44	+0.007
23	....do...... do..	..do..	..do..	.do—Ci	576	.034	33	+0.003
24	....do...... do..	..do..	..do..	.do—do	576	.032	36	+0.005
25	....do...... do..	..do..	..do..	.do—L	576	.035	57	+0.002
26	....do...... do..	..do..	..do..	.do—S. L...	576	.051	11	—0.014
27	....do...... do..	..do..	Ci...	.do—Pg	576	.028	32	+0.009
28	....do...... do..	..do..	Le . .	.do—do	576	.028	47	+0.009
29	....do...... do..	..do..	Ls . .	.do—do	576	.045	56	—0.008
30	....do...... do..	..do..	Ci...	.do—Ci	1,244	.075	33	+0.004
31	....do...... do..	..do..	..do..	.do—Le	1,244	.075	32	+0.004
32	....do...... do..	..do..	..do..	.do—Ls	1,244	.070	26	+0.014
33	....do...... do..	..do..	Le ..	.do—Ci	1,244	.081	58	+0.001
34	....do...... do..	..do..	Ls . .	.do—Ci	1,244	.095	60	—0.016
35	....do...... do..	..do..	Le ..	.do—Le	1,494	.109	56	—0.013
36	....do...... do..	..do..	..do..	.do—Ls	1,494	.102	49	—0.006
37	....do...... do..	..do..	Ls . .	.do—Le	1,494	.134	65	—0.038
38	....do...... do..	..do..	..do..	.do—Ls	2,090	.145	61	—0.049
39	....do...... do..	..do..	Ci...	Pg—Ci	668	.047	32	—0.004
40	....do...... do..	..do..	..do..	.do—Le	668	.047	32	—0.004
41	....do...... do..	..do..	..do..	.do—Ls	668	.042	29	+0.001
42	....do...... do..	..do..	Le ..	.do—Le	918	.081	48	—0.023
43	....do...... do..	..do..	..do..	.do—Ls	918	.074	58	—0.016
44	....do...... do..	..do..	Ls . .	.do—do	1,514	.089	60	+0.008
45	....do...... do..	..do..	..do..	Ci—do.....	846	.050	60	0.005
46	....do...... do..	..do..	..do..	Le—do	596	.032	57	+0.006
47	February 5, 1850	..do..	Cn ..	Wn—Cn ...	1,416	.084	45	—0.008
48	July 8..........	Bn ..	N ...	Bn—N	484	.033	63	—0.002
49	December.......	Sn...	Ps...	Sn—Ps	536	.024	221	+0.011
50	Feb. and March..	Sa...	Cn ..	Sa—Cn	596	.056	59	+0.017
51	..do...... do....	..do..	Aa ..	Sa—Aa	292	.019	40	+0.000
52	May 9, 1851	Ci...	Se...	Ci—Se	580	.040	31	+0.006
					38,294	+2.496	2,051	

From which it appears that the time of traversing 15,342 miles is one second. The column marked (obs'd—comp'd) is based upon this value.

Yours, respectfully,

SEARS C. WALKER, *Assistant C. S.*

APPENDIX No. 26.

Abstract of reports on longitudes, by Sears C. Walker, assistant in the coast survey, to the Superintendent.

CAMBRIDGE, *September* 30, 1851.

DEAR SIR: I beg to submit an abstract of all my reports on longitude hitherto made.

Harvard Observatory, west of Greenwich.

	h.	m.	s.
(A) By moon-culminations at Harvard, 1843–1845.......	4	44	28.47
" " " " Hudson, Ohio, 1838–1844..			28.62
" " " " Wilkes' obs'y, 1838–1842...			28.52
" " " " Washington obs'y, 1845....			28.06
(A) Mean by moon-culminations........................	4	44	28.42

(B) By eclipses, transits, and occultations—

	h.	m.	s.	Weight.
" At Dorchester and Harvard, 1820–1840......	4	44	32.16	— 6.4
" " Brooklyn, New York....................			31.22	— 0.4
" " Philadelphia, 1769–1840................			32.56	— 2.5
" " Wilkes' observatory, 1838–1842...........			33.13	— 1.0
" " Mean by eclipses, transits, and occultations..	4	44	32.27	—10.3

These phenomena have been reduced by Burkhardt's tables, and include, on the average, the constant error of his parallax of the moon. Airy, in his reductions of the Greenwich observations of the moon, makes the correction of this parallax to be $\triangle\,\pi_{\bigcirc}=+1''.78$. Professor Peirce and myself have computed the average value of the coefficient $\left(\frac{\triangle d}{\triangle \pi}\right)=-1s.5$, whence $\left(\frac{\triangle d}{\triangle \pi}\right)\times\triangle\,\pi_{\bigcirc}=-2s.67$; and 4*h*. 44*m*. 32*s*.27 −2*s*. 67 are—

	h.	m.	s.
(B′) Corrected mean by eclipses, transits, and occultations	4	44	29.60

(C) By chronometers with Liverpool—

	h.	m.	s.
Indiscriminate mean of 373 chronometers in all....	4	44	30.92
" " 175 " { Great special Exp. of 1849 }			30.96
Bond's " " " " "			30.10
(C) Adopting the last value........................	4	44	30.10

	h.	m.	s.
(A) Longitude of Harvard observatory	4	44	28.42
(B′) " " "			29.64
(C) " " "			30.10
Adopted for the present, Harvard observatory	4	44	29.05

Then we have, by the telegraph operations of the Coast Survey, the following results from Greenwich, depending on this assumed longitude of Harvard observatory:

	h.	m.	s.
New York, (City Hall,)	4	56	00.150
Philadelphia observatory	5	00	37.504
Seaton Station, (Washington, D. C.)	5	07	58.564
Capitol, Washington	5	08	00.853
Wilkes' observatory	5	08	00.958
Washington observatory	5	08	11.206
Georgetown observatory (Georgetown, D. C.)	5	08	17.206
Charleston observatory, S. C. (Sec. V)	5	19	43.832
Savannah Exchange, (Sec. V)	5	24	20.572
Hudson observatory, Ohio,	5	25	43.205
Cincinnati observatory	5	37	58.062

The following results depend on moon culminations and occultations:

Sand Key, Florida, (Sec. VI)	5	27	31.641
Moro Castle, (Havana)	5	29	24.000
Point Conception, (Sec. X)	8	01	42.640

Respectfully submitted:

SEARS C. WALKER, *Assistant Coast Survey.*

Prof. A. D. Bache, LL. D.,
Superintendent Coast Survey.

APPENDIX No. 27.

Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, recommending a light-house at Fishing Battery, in Chesapeake bay; and report of examination by Lieutenant Commanding J. J. Almy, United States navy, assistant in the coast survey.

Coast Survey Office, *November* 20, 1851.

Sir: I have the honor to report that an examination has been made, as required by the act of Congress approved March 3, 1851, by the instructions of the department, of the necessity for a light-house at Fishing Battery, otherwise called Donahoo's Battery, in the Chesapeake, near Havre-de-Grace, Maryland, and to recommend the construction of a tower there of fifteen feet in height, to show a light of the fourth order, or harbor light. The position proposed for a light-house is marked in the accompanying tracing from the Coast Survey map of Chesapeake bay. The details of the examination made by Lieutenant Commanding Almy, United States navy, assistant in the coast survey, are given in the report which is herewith transmitted, which also states in detail the purposes to be answered by the light, and its relations to the lights already established in the vicinity at Havre-de-Grace, and at Turkey Point.

Very respectfully yours,

A. D. BACHE, *Superintendent U. S. Coast Survey.*

Hon. Thos. Corwin, *Secretary of the Treasury.*

WASHINGTON CITY,
November 18, 1851.

SIR: In obedience to your instructions, I have made an examination of Fishing Battery, Chesapeake bay, with reference to placing the proposed light-house for which an appropriation was made at the last session of Congress.

Fishing Battery (sometimes called Donahoo's Battery) lies S. ¼ E., (true,) distant three miles from Havre-de-Grace light-house, and NW. ¾ W. (true,) distant five and a half miles from Turkey Point light-house. It is upon the edge, on the southwest side of the extensive flats off and abreast the mouth of the Susquehanna river. The channel for loaded vessels leaving Havre-de-Grace for Baltimore, runs by and within half a mile of Fishing Battery, and when abreast of it, vessels have to change their course at right-angles; therefore I unhesitatingly say, that for vessels running at night I consider it necessary to have a light here.

The kind of light which, in my judgment, would best answer and subserve all necessary purposes, would be a beacon light—a fixed dark red light, elevated about fifteen feet above the surface of the water. Owing to its relative position to Havre-de-Grace light and Turkey Point light, the light to be placed upon Fishing Battery would not require to be seen a distance exceeding five miles. I recommend a fixed dark red light, because both Turkey Point light and Havre-de-Grace light are fixed lights of a whitish color.

Fishing Battery has piles already driven, partially planked over, and there are sheds and buildings of a rough, rude structure, for the accommodation of fishing operations. I cannot speak with certainty as to whether these piles are driven firmly enough into the ground, or whether they are in a sufficiently sound condition for a foundation upon which to erect a structure for a light. To ascertain this, the planking will have to be taken up, and an examination made by a person thoroughly versed in such matters.

I am, sir, respectfully yours,
JOHN J. ALMY,
Lieutenant U. S. Navy, Assistant Coast Survey.

Prof. A. D. BACHE,
Superintendent Coast Survey.

APPENDIX No. 28.

Extracts from the report of Henry L. Whiting, Esq., assistant in the coast survey, to the Superintendent, on the survey of Beaufort, North Carolina.

WASHINGTON, *May* 13, 1851.

DEAR SIR: * * * * *

The survey is extended, on the outside shore, about three miles from either point of the inlet, and beyond the limits of the bar and shoals of its entrance. In the harbor and about the town, I have carried the survey *beyond* all the important localities, so as to fully *include* all the channel-ways connecting the harbor with the interior waters, and furnishing

topographical detail to show the approaches by land to the best water and landings, with the character of the shore, which is of course represented in our conventional signs.

I have also made as accurate a survey as their character will admit, of the shoals and bars within the harbor, as they exist at low water of ordinary spring tides.

* * * * * * *

In reporting upon the natural character and peculiarities of Beaufort, as a harbor and port, I will state such facts as have come under my personal knowledge, and also communicate my opinion regarding its entrance and the facilities it might afford to the commercial interest of this region.

The outside beach, or "bank," opposite Beaufort harbor, is of the usual formation of this coast. It is mostly covered with a low pine, and mixed growth, and its average width is about half a mile; the sand hills and ridges upon it are from 20 to 35 or 40 feet high, thus forming a good and sufficient shelter, from both wind and sea, to all vessels anchored inside the banks; the holding-ground is also good, as shown by the results of the hydrographical survey.

The interior shores of the harbor are mostly of marsh, grown with masses of oyster-beds and shells, which, near the edges and where the sand has united with them, are quite hard and solid. At Lenoxville and Shepherd's Point, and at the town of Beaufort, the main upland comes to the water's edge. At the two former points, the deep waters of Newport and North River channels approach quite near the shore, and without any intervening shoals.

During the last thirty years there does not appear to have been any particular change, either in the shore-line or shoals *within* the limits of the harbor. The causes and action of tide, &c., which first formed them, seem to continue them in their general position and extent.

That the inlet and bar of Beaufort are probably the best on our whole eastern seacoast, south of the Chesapeake bay, is, I believe, a matter of fact, and needs no comment.

There are two principal causes which, I think, have preserved this inlet, and will continue to keep it open, with probably deeper water than any of the other harbors on this coast.

One of these causes is the shelter and eddy currents occasioned by Cape Lookout. The influence of these currents upon the inlet, opening as it does to the south, and in the "bite" of the cove immediately under it, is, to cut and carry away the sands and shoals which storms may throw up, and deposite them at the point of the cape. At least, it is obvious that the influence which has formed Cape Lookout, and creates the deep water and bold shore of this cove immediately south of it, will not allow any deposites to take place at a point where the eddy and counter-currents have their greatest effect; while the projection of the cape, and the shoals extending beyond it, prevent the action of the sea within this cove from being as great, or having the same effect, as upon a coast presenting an unprotected and nearly even outline to the action of storms and breakers, as is the case on the shores both above and below Cape Lookout and Cape Hatteras.

The other influence which I think will always tend to preserve the inlet at Beaufort, is from the non-existence of any large interior sound or bay.

The current through the inlet is wholly a tidal one, and the back waters of "Borgne" and "Cove sounds," and from "Newport" and "North" rivers, accumulate no more on the flood tide than escapes on the ebb; they are also of such extent and so located as to be materially affected by the tide, being filled and emptied by the flood and ebb, and there are no fresh-water feeders to either of the rivers sufficient to at all affect their currents.

There is thus a strong and continual tidal current through the inlet, and this current is not lost or overpowered by a heavy swell from sea, deadening its effect and throwing back the sand, which it displaces, in shoals and bars; but it runs with the eddy currents of the cove into which the inlet opens, and the same action and effect is continued that the current out of the inlet produces, all tending to preserve and deepen the channel.

In comparing the inlet at Beaufort with Ocracoke and others opening from the large sounds, the advantages and disadvantages of either are obvious. These latter are almost as much exposed on the inside to the great mass of waters in the sounds as they are on the outside to the ocean. The effect of storms and tides is consequently great as well as uncertain. Heavy storms from the westward prevent the tide from flowing through the inlets from the ocean, while the water and surf from the sounds heave up swashes and shoals on the inside.

The action of storms from sea is still worse, while the waters of the sounds are driven back and shoals are thrown up and formed across the mouth of the inlet, without any counter influence to prevent or carry them away.

In a commercial point of view, Beaufort, as a harbor and port, has many advantages and is well situated. There is no river or inland navigation to delay or require the towing of large vessels. A ship drawing 20 feet water can leave at any state of the tide with almost any wind, and discharge her pilot *at sea* in from 30 to 45 minutes after weighing anchor.

It seems, therefore, that the usefulness of one of the best harbors and ports on our whole southern coast is lost from the want of proper facilities of communication and internal improvements, giving access to it from the interior country and cities.

* * * * * * *

I remain, sir, very respectfully yours,

HENRY L. WHITING.

Prof. A. D. Bache,

Superintendent U. S. Coast Survey, Washington.

APPENDIX No. 29.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating a report of Lieut. Com. J. N. Maffitt, U. S. N., assistant in the coast survey, upon the necessity for certain aids to navigation in Beaufort harbor, N. C.

COAST SURVEY OFFICE,
February 27, 1851.

SIR: I have the honor to transmit a report just received from Lieut. Com. J. N. Maffitt, U. S. N., assistant in the coast survey, of buoys and beacon (or range) lights, required in the harbor of Beaufort, North Carolina, the hydrography of which has been executed by the party under his command, and would respectfully request that it may, with the accompanying sketch showing the position of the beacons and lights, be transmitted to the authority which should act in the matter.

Very respectfully, yours,

A. D. BACHE,
Superintendent U. S. Coast Survey.

Hon. THOMAS CORWIN,
Secretary of the Treasury.

Report of Lieutenant Commanding John N. Maffitt, U. S. N., assistant in the coast survey, to the Superintendent, in relation to lights and buoys in Beaufort harbor, N. C.

UNITED STATES SCHOONER GALLATIN,
North Edisto, S. C., February 8, 1851.

SIR: I respectfully propose the following improvements in the harbor of Beaufort, N. C., for the purpose of rendering it safe for a vessel to enter without a pilot, by day or night, viz:

1st. *A single bug-light* on Shackleford Point, due north of Bar buoy, (which should be brought to bear north and then run for, until the first range course is made.)

2d. *Two bug-lights* west of Fort Macon, to be placed in range for *first course* after passing the Bar buoy. (See sketch.)

3d. Two bug-lights—one on Macon Point, the other on the marsh in the rear—giving the range for course No. 2. (See sketch.)

4th. A buoy on 10-foot spot, and marked on the sketch *Buoy No.* 2.

5th. A buoy on the south spit of the middle ground, marked on sketch *Buoy No.* 3.

6th. A buoy in mouth of the Slue, marked on the sketch *Buoy No.* 4.

7th. A buoy on the west side of the middle ground, marked on the sketch *Buoy No.* 5.

With such guides a stranger could enter, by day or night, without fear.

Respectfully, &c.,

J. N. MAFFITT,
Lieut. Com., Assistant U. S. Coast Survey.

Prof. A. D. BACHE,
Superintendent U. S. Coast Survey.

APPENDIX No. 30.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating a report of Lieutenant Commanding J. N. Maffitt, U. S. N., assistant in the coast survey, on the necessity for a light-house on the upper jettee, Cape Fear river, N. C.

CAPE SMALL POINT,
Near Bath, Maine, October, 15, 1851.

SIR: I have the honor to report, that in conformity with the act approved March 3, 1851, making appropriations for light-houses, buoys, &c., and the instructions of the department, the question of the necessity for a light-house on the upper jettee of Cape Fear river has been examined, and that I recommend the construction of the same, for the reason assigned in the report of Lieutenant Commanding J. N. Maffitt, United States navy, assistant in the coast survey.

The report of Lieutenant Maffitt is herewith transmitted, with the "eye-sketch" which accompanied it.

Very respectfully, yours,

A. D. BACHE,
Superintendent U. S. Coast Survey.

HON. THOMAS CORWIN,
Secretary of the Treasury.

SMITHVILLE, N. C., *September* 12, 1851.

DEAR SIR: I have visited the "upper jettees of Cape Fear river," and herewith enclose to you an "eye-sketch" of that section, where some improvements are requisite for the benefit of navigation.

On the upper eastern jettee (No. 2) a light is certainly required, that steamers and sailing-vessels bound down at night may be enabled to keep the "fair channel way," which they cannot always do at present, from the fact, that as the field of view is opened from just above Graham's island, jettee No. 2 trenches entirely athwart the *apparent* channel, and there is no guide which will enable a mariner to calculate how to steer, in order to clear this jettee, and keep in the best water, which is close to its end. The same holds good (from the sudden bend of the river) in sailing up.

It is not an uncommon circumstance at night for vessels to misjudge their distance, and run into jettee No. 2. The upper western jettee is out of the channel way; a light there would be useless.

The "reaches" over "Wreck shoal" are not long enough to warrant the erection of "range lights."

I consider it necessary that the present buoys be *replaced* by *larger ones;* and as the forest on each side gives a dark back-ground, they should be painted *white;* they would then always be seen on a starlight night.

I also propose that "tripods," painted white, be erected on jettees Nos. 3, 4, and 6. They would materially assist the navigator in

avoiding the shoals, and *jettees themselves*, which are low in the water, dilapidated, and more dangerous to vessels than beneficial to the river.

*　*　*　*　*　*　*　*

A requisite light-house for the upper eastern jettee should not cost over four thousand dollars.

Very respectfully, your obedient servant,

J. N. MAFFITT,
Lieut. Com. and Assistant Coast Survey.

Prof. A. D. BACHE,
Superintendent U. S. Coast Survey, Washington.

APPENDIX No. 30, *bis*.

Letter from the President of the Chamber of Commerce of Charleston, S. C., to the Superintendent of the U. S. Coast Survey, requesting a tracing of the chart of Charleston harbor.

CHARLESTON, *June* 18, 1851.

DEAR SIR: At an extra meeting of the Chamber of Commerce of Charleston, held this day, the enclosed resolution was unanimously adopted, and I was instructed to transmit you a copy, and express the hope that you may be able conveniently to comply with our request.

We desired a copy of this chart to assist us in forming some opinion of the best method of improving the entrance to our harbor. Public attention has long been attracted to the "Sullivan's island" channel, as offering strong inducements to attempt some improvements there, and the developments made by the Coast Survey tend strongly to encourage this feeling. If you have had your attention attracted to this subject, and adopted any definite views in relation to it, you would be doing essential aid to a subject of vast public importance and profound interest to our community by making your opinions known.

Yours, with great respect,

G. W. TRENHOLM,
President Charleston Chamber of Commerce.

Prof. BACHE, *Washington.*

Resolved, That Professor Bache be respectfully requested to furnish the Chamber of Commerce, for the use of the mercantile and navigating interests of Charleston, a tracing of the chart of Charleston harbor, recently constructed under the direction of the Coast Survey.

APPENDIX No. 30, *tris.*

Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating sailing directions for the entrance into North Edisto harbor, by Lieutenant Commanding J. N. Maffitt, United States navy, assistant in the coast survey.

COAST SURVEY OFFICE, *April* 28, 1851.

SIR: I have the honor to communicate the following information, supplied by Lieutenant Commanding J. N. Maffitt, United States navy, assistant in the coast survey, in relation to North Edisto harbor, and to request authority to publish it for the benefit of navigators:

"This harbor of refuge is about sixteen miles to the southward and westward of Charleston light-house. It is easy of access—one course over the bar taking the vessel to a safe anchorage.

"In four fathoms water, (with the point of Seabrook island, on the north side of the harbor, bearing northwest,) you will be close up to the bar.

"Bring Bare bluff (a remarkable clump of trees which stands back from the entrance about ten miles, and can be easily recognised by four tall trees rising above the others) about four hand-spikes to the left of Seabrook point, and run in on that range.

"When almost off the starboard sand-spit, keep in mid-channel, to avoid a sand-flat on that shore. By keeping near mid-channel, good water may be carried up to the anchorage, abreast of Mr. Legaré's, (the first house upon the port shore.)

"At 'mean low-water' there are thirteen feet on the bar. The mean rise and fall is six feet. The ebb-tide on the bar tends to the southward and eastward—the flood north-northwest.

"The establishment of North Edisto, for two months' tidal observations in 1851, is seven hours nine minutes."

Very respectfully, yours, &c.,

A. D. BACHE, *Superintendent.*

Hon. WM. L. HODGE,
Acting Secretary of the Treasury.

APPENDIX No. 31.

Report of F. H. Gerdes, esq., assistant in the coast survey, to the Superintendent, on the reconnaissance of the coast of Florida, from the Suwannee river to the St. Martin's reef.

PASCAGOULA, *December* 20, 1850.

SIR: In compliance with your orders, I left Pascagoula November 2d, for the Cedar keys, Florida.

* * * * * * * *

The first section was the Cedar keys and the reefs to the eastward; then I examined Wacassassa bay, Suwannee reef, Withlacoochee bay, Crystal river, and St. Martin's reef.

Observations for latitude and time were made almost daily. A tide-gauge was kept for about twelve days, and the necessary soundings to mark the several channels were taken. The heights of several hills were measured, and a special reconnaissance was made for a base to be used for a preliminary survey. A small base, upon which all the bearings and angles depend, was twice measured, and, on many important points, signals were left to designate them.

Description of the Coast.

1. *Suwannee river and bay.*—The Suwannee, one of the principal rivers on the coast of Florida, is deep, and has very fertile lands on its borders. The country is flat and densely wooded—the forests consisting of pine and other kinds of timber. Sugar and cotton are cultivated in considerable quantities, and many acres are cleared yearly in the hammocks. The mouth of the river is shoal—bars obstructing both outlets. The lower or southeast outlet, however, is the best, and is now generally used. The northwest outlet, near Bradford's island, is entirely abandoned. An oyster reef runs, in a horse-shoe shape, before this river, and forms the Suwannee bay, which is equally shoal. More than five feet at high-tide cannot be carried either over the bar, into the bay, through the bay, or into the river itself. A steamboat plies on the river to Depot key, carrying passengers and produce (cotton and sugar) to the shipping places of the vicinity.

2. *Cedar keys.*—The Cedar keys form a group of islands making out from a point of the main land, just below the Suwannee reef, to the southward. The greater portion of these keys is connected with the main, and only at high tides they are separated by small boat-channels. Several of the keys, however, extend for a few miles farther to the southward, and these, of course, are islands proper.

The Cedar keys consist of Way key, Scale key, Big key, Flat key, Black Point key, and numerous others, only divided by small passages; none of which, however—except old No. 4 channel—are fit even for boats. The keys are cut up into numberless patches of marsh sand, beach, mangroves, and wood; but as the surface was surveyed in detail by the corps of topographical engineers, I have only delineated the outlines. On Way key there is an elevation of about fifty feet; and other hills, of a minor class, are formed on Lime Point, Black Point key, Live-oak key, &c. The islands proper belonging to the Cedar keys are North key, Sea-horse key, Depot key, Snake key, Derrick's key, Dog island, and several minor ones.

North key is wooded—has two large ponds—is hilly in the middle, and has a house on it, though uninhabited.

Sea-horse key is the southern key—is forty-five feet high—has a long, hilly ridge, an uninhabited house, and an excellent harbor close to the eastern point. In the war with the Indians, Sea-horse key was occupied by our troops.

Depot key is the anchorage of the Cedar keys—is inhabited by ten or twelve families, and affords quite a fine view. There are here hospitals and storehouses, and several cottages, overhung by tall palmetto trees. A handsome wharf, and the appearance of business, enliven

the sight. All the cotton and sugar of the neighboring rivers are taken by flats to this place, and shipped from here either to Mobile or to New York. From fifteen to eighteen vessels arrive here yearly for this purpose, and probably as many more transient ones.

Snake key forms a triangle with the Sea-horse and Depot keys, is hilly, but small, and affords some protection to the harbor of Depot key from southeast winds.

Derrick key, situated to the west of the main group, is small, and separated from the others by the steamboat channel to the Suwannee bay.

Dog island, northeast from the Depot, is small and low, and contains only mangroves and a few cabbage-trees.

Channel No. 1—*three channels.*—The principal channel to the anchorage at Depot key runs east of the Sea-horse, and fourteen feet have been carried in here, at a good tide. The channel is plain enough, when known and well staked out.

Channel No. 2—small channel just below the Sea-horse, across the reef—is little used; but I am assured that eight feet water may safely be carried. A survey of this channel would be useful for smaller vessels, as it would avoid the necessity of doubling the Sea-horse reef, (fifteen miles long.)

Channel No. 3.—Another channel comes in from the westward, between Sea-horse and North keys, just above (north of) Bird key. At a good tide, nine feet may be carried in. The channel is plain and well staked out.

Channel No. 4.—This channel, although it has the best water, is very little or not at all used, as it does not extend to the anchorage. It runs from the westward about half a mile above North key, and carries fourteen feet of water to the first and second Mangrove keys; then it suddenly stops, and the anchorage at the termination remains quite exposed to westerly winds. It might be used in good seasons, with the aid of lighters, but it would be unfit for the railroad terminus, for the above reason; and, besides, it would be very expensive to extend the track so far over very low, marshy ground, and partly over shoal water.

The reef of Sea-horse key runs from the Sea-horse for ten miles SW., and thence for five miles SSW., and has shallow spots of only a few feet of water. A moderately-sized coasting vessel touched lately on the southernmost point, not having Sea-horse key even in sight.

4. *Wacassassa bay.*—The coast of the main from Cedar keys runs for more than ten miles in nearly an eastern direction, viz: from Live Oak Point, and "old block-house No. 4," (garrison fort of the Florida war,) to the Wacassassa river, from whence an angle to the south is formed. The coast is flat, and for one or two miles inland marshy, where the dense and uninhabited forest commences, and stretches for miles into the country. This whole shore is a complete oyster-bed; I never in my life saw such enormous quantities together. Many reefs formed of the same shell run across the bay, mostly in a parallel course with the coast.

One channel, between the western reefs, carries eight feet water in the bay; another, between the eastern reefs, has ten feet; but they stop suddenly. The Wacassassa river is similar to the Suwannee river; has very fertile hammocks on the borders, and the plantations of sugar and

cotton are in a flourishing condition. The soil contains marl, and, it is said, under the same for sixteen feet, clay. The depth of the river is considerable, but not more than five feet can be carried, under the most favorable circumstances. All shipments from here are made in flat-boats, to Depot key.

5. *Withlacoochee bay.*—Below, to the south of the Wacassassa bay, the Withlacoochee bay begins, and forms the mouth of the river of the same name. The shores of the bay are similar to those of the Wacassassa—low, flat, marshy, intermixed with mangrove bushes, and a mile or two inland very thickly wooded. The point of land in the middle, between the two rivers, is called Mangrove Point. The whole bay is very shoal, and not more than three or four feet of water can be carried into the river. The latter has very little hammock land, and is less settled than the other rivers, perhaps on account of the difficulty of navigation. An oyster reef extends a few miles from the river's mouth into the bay.

6. *Crystal river and bay.*—From the Withlacoochee the shore runs southward, making a slight curve to the east. Five miles below is the Crystal river. The nature of the border is similar to the Wacassassa and the hammock land, equally fertile and rich. At the mouth of the river is Shell island, the channel into the river running on the north side. The island is rather elevated, being formed by two hills in saddle-shapes, which make a fair landmark for navigation. From the mouth of the river, or rather from the south side of the entrance, the St. Martin's keys commence, and extend for two or three miles to the west, thence turn in an angle southward again. These keys are low and marshy, and generally thickly covered with mangroves. Outside of these is the famous and very dangerous St. Martin's reef, which runs parallel to the coast, to the southward, and extends at some points as far as ten miles to sea. It is said this reef extends to the Anclote keys, a distance, perhaps, of from fifteen to thirty-five miles, which I am inclined to believe. While I was beating up the coast, I generally ran in nine or ten feet of water on the land tack, without ever being able to see the coast.

To the north of this reef, just abreast of Crystal river, is a fine anchorage, into which vessels may run for refuge, with from sixteen to twelve feet water, perfectly safe for southerly, easterly, and northerly winds. Even from westerly gales there is much protection here, the Sea-horse reef breaking much of the heavy sea. I have called this anchorage Crystal river offing, as the name St. Martin's bay is altogether inappropriate, and does not designate the place. From the offing a channel runs through the oyster reef, which encircles the mouth of Crystal river, and consequently forms a beautiful harbor. I found twelve feet at low tide through the principal gut; and, as the inlet is the only one of any consideration, I have left two large signal-poles on each side, on the oyster bars. It must be borne in mind that the tide rises here two, and frequently three feet, and that therefore, under favorable circumstances, fourteen feet can be carried in. The importance of such a harbor is very great, as it must and will become the shipping port of all the produce for the neighboring rivers, viz: the Withlacoochee, the Crystal river, the Homossassa, and the Chassahowitzka. The

Homossassa is only five miles below the Crystal river, and the Chassahowitzka about ten miles; but neither has any channel through the St. Martin's reef, and their produce, which will be in a short time quite considerable, has to be shipped from the nearest harbor.

The honorable Senator from Florida, Mr. Yulee, mentions, in a letter to you, the reported existence of a harbor and anchorage below the Cedar keys, with fourteen feet water, but he does not intimate the position nearer. I am certain that the harbor of Crystal river is the one he mentions, as there is no other channel to be found anywhere above.

B.—Survey of the Coast.

1. *Triangulation.*—The country from the Suwannee river to Homossassa river is so shaped that the regular method of the Coast Survey in all branches may be employed for the survey of the same. There are facilities which may be used in laying a good-shaped triangulation with very little clearing across the islands and along the coast. With the aid of several oyster bars, which are solid and above high-water mark, the shape even may be handsome, although the nature of the flat country does not admit of very large sides. The triangles, as projected on the map, will show at once the possibility, and, with one or two exceptions, the whole series will appear well-shaped and of regular formation. The sketch shows the proportions, facilities, and difficulty of the triangulation. One of the above-mentioned exceptions is an artificial signal to be erected off the Withlacoochee river. Without making a proposition at present, I should think that one or two screw-piles for soft bottom (I say two for a double series) would answer exceedingly well.

Signal-poles can be procured from either river, especially on the Wacassassa.

2. *Topography.*—There being little or no land under cultivation near the coast, the whole being marsh and wood, the topography will be very simple. To extend the survey further into the country than the woods would be impossible, as they are impenetrable for instruments; besides, there is nothing behind them. The plantations on the river generally do not approach nearer than seven or eight miles to the shore, and therefore cannot be included in the survey. A plane-table may be used here with great success, as the off-shore reefs afford a thousand opportunities for intersecting signals. The surveying compass must be employed with great care, as the coast from Mangrove Point above the Withlacoochee, all the way down, is rather rocky, and supposed to contain much local attraction.

3. *Hydrography.*—The hydrography can be carried on with success in small vessels and boats. There is seldom any sea inside the Sea-horse reef. Snake key and the Sea-horse being elevated, afford excellent points for high signals.

4. *Astronomy.*—Sea-horse key, being the most important key for navigators, possesses all the facilities for an astronomical station.

5. *Base lines.*—I have paid every attention during the investigation of the coast to find suitable sites for a base line, upon which the triangulation may be grounded, but I have been unsuccessful so far. The marsh along the shore has no stability for our apparatus; the land,

wherever it is solid, is uneven or thickly wooded. A more special reconnaissance has to be made for the purpose: perhaps more to the northward a site may be found, combining in a moderate degree the necessary requisites. If the railroad should be built, we may get a site then from Way key. As it is now, nothing there is to be found. Even for a preliminary base, the best site I could find is only one and a quarter mile long, and requires much clearing and labor—touching, besides, two ponds, the distance of which has to be ascertained by triangulation and measurement around. From here, however, the triangles may be gradually increased and retain good forms. The line is on Way key. A topographical sketch of the site is appended.

The atmosphere on the coast, during my stay, was rather hazy, but not near so bad as we find it generally in Section VIII. Five days, however, it was perfectly clear, and Sea-horse key was seen distinctly for twenty miles. Refraction was sometimes very great.

C.—Tides and Currents.

During my stay at the Cedar keys the tide was observed, on the wharf of Depot key, for seven days. The diagram on the map will show that it consists of a full and a neap tide nearly every twenty-four hours. The following are the results:

Mean-tide rises and falls	1 foot 9.8 inches.
Spring-tide " " "	2 feet 7.5 "
Average of both rise and fall	2 " 2.4 "

Time of rise and fall, 24 hours 40 minutes.

In the map of Cedar keys published by the Topographical Engineer corps, the average rise and fall is 2.75 feet. I do not know whether my observations were of too short a duration; but the above is what I found.

On the coast outside and to the southwest of the keys, the general tendency of the current is to the southward. It is uncertain how much prevailing winds and storms may influence them. The pilot of the keys asserted that the currents were altogether governed by them, and that sometimes they run in quite an opposite direction.

D.—Railroad across the Peninsula of Florida.

By the survey of the officers of the United States Topographical Bureau, it appears that Way key was proposed as the terminus of the railroad on the gulf shore. How far this, in regard to the track itself, is advisable, I cannot judge; but it seems to me, certainly, by far the most desirable spot in regard to the harbor. At Way key and Depot key there is a safe anchorage; and although the channel is rather narrow, still it is sufficient for vessels of large size to turn in. Twelve feet may be carried, ordinarily. The pilot, Captain Sam. Johnson, assured me that fourteen feet can be carried, if circumstances are favorable.

The only harbor besides this is Crystal harbor; but vessels have to lie about two miles from the main land; and furthermore, the railroad itself would have to cross several rivers and marshy plains to reach this shore.

E.—Light-houses and Buoys.

There are no lights in the neighborhood of Cedar keys; but I hear that an appropriation for one has passed in Congress, and Captain M. Coste, of the revenue service, in the cutter Crawford, has made an investigation for the special locality. I am confident that Sea-horse key has been selected for that purpose, as there is no other place near so suitable; but as I have had probably more opportunities to see the localities than the above-mentioned gentleman, during his short stay, I beg leave to remark, that on Sea-horse key the highest land is just to the southwest of an old shanty, or fish-house, which stands on the east beach of the island. By actual measurement, by vertical angles, I found 45 feet 6 inches above high-water. As the reef from this key runs out for fifteen miles, it will be desirable to occupy the highest spot, that the light may be visible from beyond it. There ought to be a buoy placed on the point of this reef, by all means. In foggy weather the Sea-horse is invisible from there, and the reef is very difficult to distinguish, as the water outside deepens only gradually, and retains the same color. A screw-pile, (disk-screw,) with a barrel, could be inserted easily, the reef having only quicksand and a sort of coral sand.

F.—General Remarks on the Harbor of the Cedar Keys.

It is obvious, by looking at the map of the western coast of the Florida peninsula, that in a severe southwest storm the navigation must be very dangerous. From Tampa Bay to St. Mark's the coast is generally shoal, and, with the exception of the Cedar keys, no harbor of refuge is to be found. At the latter place the coast forms a point, and through the position of the keys and Sea-horse reef, quite a large bay is formed, in which vessels may run with almost every wind, and find shelter at any time.

This will be still more the case when the light-house on the Sea-horse key has been built, by the aid of which every part of the bay may be safely entered in dark and stormy nights. Not alluding at all to the commerce from the four or five rivers which empty, close to the keys, into the Gulf, and which is concentrated entirely at Depot key, but alone for the sake of a safe and spacious harbor in westerly gales, it is most desirable to develop all the facilities which the Cedar keys bay may afford, and to commence a regular survey at the earliest opportunity. Five large streams are, in fact, combined at the Cedar keys, and the produce to be shipped from there doubles yearly. The place will become still more important after the building of the railroad from the St. Mary's across the peninsula, and the erection of a light-house on the Sea-horse.

A survey, grounded upon a preliminary base, might be made in a short time, and it would be practicable to publish a harbor chart comparatively very soon.

Respectfully submitted:

F. H. GERDES,
Assistant Coast Survey.

Prof. A. D. Bache,
Superintendent Coast Survey.

APPENDIX No. 32.

Extracts from the report of Lieutenant Commanding John Rodgers, United States navy, assistant in the coast survey, to the Superintendent, of a reconnaissance of Mosquito inlet.

UNITED STATES COAST SURVEY OFFICE,
Washington, July 19, 1851.

SIR: * * This inlet is made by the Halifax and Hillsborough runs, which, at their meeting, force an outlet to the sea.

Mosquito inlet has, for a number of years, been moving to the southward. The light-house formerly erected at Mosquito was built upon a high sand-hill on the southern peninsula, about an eighth of a mile from the water. In two years it fell down, undermined by the southward movement of the inlet. The place of the light-house is now said to be about high-water mark on the north beach.

The south beach is still rapidly washing away, and the north beach extends to the southward as fast. Mr. Sheldon, collector at Mosquito, says that the barrier about half a mile to the northward of the present position of the inlet is rapidly washing away. He infers that the water will soon cut a passage there, when this new opening will become the entrance to the harbor, and the present inlet close. His opinion is the result of long observation. I have no means of forming any opinion of my own as to its correctness.

As many as thirteen small vessels have, I understand, been lying in the harbor at once, waiting for cargoes of live-oak, but none very lately. A few plantations make sugar, which is here exported. I did not learn of any other trade worth mentioning. I do not deem the commerce of Mosquito sufficient to demand the erection of a light-house.

* * * * * *

Very respectfully, your obedient servant,

JOHN RODGERS,
Lieut. Com., Assistant U. S. Coast Survey.

A. D. BACHE, LL. D.,
Superintendent Coast Survey.

APPENDIX No. 33.

Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, in regard to the expediency of placing buoys in Mosquito inlet, Florida, and transmitting the report of Lieutenant Commanding John Rodgers, United States navy, assistant in the coast survey.

COAST SURVEY STATION,
Near Alfred, Maine, October 1, 1851.

SIR: In pursuance of the act of Congress approved March 3, 1851, and of the instructions of the department, I have the honor to report in regard to the expediency of placing buoys in Mosquito inlet, on the

eastern coast of Florida, and to transmit for details a report of Lieutenant Commanding John Rodgers, United States navy, assistant in the coast survey, by whom an examination of the inlet was made. I send herewith a copy of the sketch of the reconnaissance.

I concur in recommending the placing of these buoys as stated by Lieutenant Commanding Rodgers, with the precautions which he suggests for their maintenance in the right positions, and for the change of place of the bar buoys according to the change of the bar itself.

I would further recommend that Lieutenant Commanding Rodgers be intrusted with the placing of these buoys in the first instance—a duty which can be performed as he returns to Section VI, the coast of Florida.

Important suggestions of local signals for pilotage of barred harbors are given in Lieutenant Commanding Rodgers's report, and are hereto appended for the examination of the department.

Very respectfully, yours,

A. D. BACHE,
Superintendent.

Hon. Thomas Corwin,
Secretary of the Treasury.

United States Coast Survey Office,
Washington, August 29, 1851.

Dear Sir: The position of the proposed buoys at Mosquito inlet, Florida, cannot be usefully marked on the sketch.

As the bar shifts with every gale, the best water is not now, in all probability, where it was when the examination was made.

I think three buoys would be ample. I venture to propose a second-class buoy outside of the bar; a third-class buoy inside; and a third-class buoy at the bar.

To be useful, or rather that it may not become a nuisance, the bar buoy must be carefully attended, and its place changed with every alteration in the position of the channel. For this buoy spare moorings should be furnished, as it is probable that after every change of bar the shifting sand will so have covered the anchor that every attempt to weigh it will be fruitless; in which case, to unshackle the buoy and expend new moorings will be the only resource.

The collector is allowed boat hands. These men might be required to keep the buoy in the best water, and the collector be held responsible in his office for the faithful discharge of this duty. To this end a log or frame house should be erected on the beach for the men to live in. The beach washes away so fast that it is scarcely desirable to use more durable materials.

There is now no regular pilot for Mosquito, because there is not enough commerce to support one. The boat hands employed to keep the buoy in the best water would necessarily know the state of the bar, and be competent to point out the channel. Living on the spot, they would always be ready to pilot vessels. Mount Pleasant is the

nearest habitation to the inlet; and at present, since no look-out is kept, it is only by chance a vessel is seen.

On account of the breakers it is often impossible for a row-boat to cross the bar; the pilot must then wave the vessel in by means of a flag. In such harbors conventional telegraphs are established, as at St. Augustine, Florida, and Rio Grande de San Pedro, in Brazil, by which the vessel indicates her draught of water, and the pilot gives directions to her for keeping in the channel.

It is desirable that this telegraph should be general to all the barred harbors of the United States, and not varied in different localities, and at the pilot's discretion.

I have ventured to propose the annexed table as perhaps sufficient. It is simpler than the Brazilian telegraph, and fuller than the St. Augustine one.

Such modifications as may be deemed necessary can easily be made on it.

Very respectfully, your obedient servant,

JOHN RODGERS,

Lieut. Commanding, and Asst. Coast Survey.

To A. D. Bache, LL. D.,

Superintendent Coast Survey.

Table of signals for piloting vessels into barred harbors.

The pilot's flag to be seven feet by six in size, and to consist of two triangular red pieces of red muslin, or bunting, enclosing a white triangle of the same materials, fastened to a staff twelve feet long and one inch in diameter. The end of the staff to have a barrel hoop firmly lashed to it, and to have stretched over the hoop a piece of muslin, the upper half white and the lower half black.

The pilot boat to approach the bar as nearly as she safely can. The pilot lays on his oars, or anchors his boat. The boat should be fitted with an awning stanchion aft, and a strap around it, for the pilot to make himself fast to, that he may stand steadily while signalizing.

Sentences to be communicated to the pilot by the vessel.	Signals for sentences opposite.
1. The vessel wants a pilot	Jack at the fore.
2. Indicate my draught	Dip the flag once for every foot which the vessel draws, and run it half up and dip it once for every quarter of a foot.
3. In distress; I must try to come in at high water.	Flag, union down.
4. In distress; I must try to come in now	Flag, union down, dipped four times.
*5. I am sinking, or on fire; run me ashore in the best place.	An overhand knot in the middle of the flag, dipped four times.

* The bar is not always the best place for beaching a vessel while the breakers are very heavy on it; there may be a comparatively smooth place on the sea-beach.

Table of signals—Continued.

Sentences to be communicated to the vessel by the pilot.	Signals for the sentences opposite.
1. Pilot cannot come out; what water does the vessel draw.	Wave the flag to right and left.
2. Not water enough on the bar until high tide.	Pilot raises the flag over his head, and dips it towards the vessel once for every hour she must wait.
3. The vessel connot enter until the wind changes.	Flag and ball horizontal; staff held by the middle.
4. Not water enough on the bar; seek another part.	Waves black and white ball to right and left.
5. Vessel cannot cross the bar until the sea goes down.	Ball inclined 45 degrees to the horizon; flag in left hand, as pilot faces the vessel, and staff in the right hand.
6. The vessel may get under way and stand for the bar.	Pilot holds the flag erect over his head, and keeps it so until the vessel weighs; he may incline it the way he wishes her to cast.
7. Steer the vessel to starboard, or port the helm.	Incline the flag to starboard. } In both these signals the flag points out the side to which the vessel must steer.
8. Steer the vessel to port, or starboard your helm.	Incline the flag to port. } In both these signals the flag points out the side to which the vessel must steer.
9. Steady, or steer as you go..............	Dip the flag out of sight.
10. Steer for the pilot boat................	Flag overhead; staff upright.
11. Anchor..................................	Ball overhead; flag in pilot's hand.

APPENDIX No. 34.

Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, upon the necessity for a light-house, or permanent beacon, on the Rebecca shoal, between the Tortugas and Marquesas, Coast of Florida.

Coast Survey Office,
November 22, 1851.

Sir: I would respectfully call the attention of the department to the necessity for a light-house, or at least for a permanent beacon, on the Rebecca shoal, between the Tortugas and Marquesas, in the Gulf of Mexico. The position of the shoal is shown in the annexed sketch. It lies in an important thoroughfare for vessels bound into the Gulf, and is not now marked. My attention has been called to this subject by Assistant F. H. Gerdes, of the Coast Survey, who made the reconnaissance of the Florida keys and reefs, and who has presented two drawings—one for a beacon to serve as a light-house, and the other for a simple beacon—which are at the disposal of the department, if their communication is desired. I send herewith a letter of Lieutenant Commanding John Rodgers, United States navy, assistant in the Coast Survey, in charge of the hydrographic party on the coast of Florida,

to Mr. Gerdes, in reply to his inquiries relative to the necessity for a light on the Rebecca shoal, and to the plan for a structure to contain it.

Very respectfully, yours,

A. D. BACHE,

Superintendent United States Coast Survey.

Hon. Thomas Corwin,

Secretary of the Treasury.

Coast Survey Office,

Washington October 21, 1851.

Dear Sir: In reply to your letter of this morning, I beg leave to say that I think no doubt can exist in the mind of any person acquainted with the facts of the case, as to the great necessity to commerce of a beacon on the Rebecca shoals.

The passage between the Marquesas keys and the Tortugas is a great thoroughfare for vessels bound into the Gulf of Mexico. By taking this passage the time to ports in the gulf is shortened more than the mere distance cut off, since the current is thereby avoided sooner. To sail vessels this is, in light or head winds, of the greatest importance.

The shoals which lie in this passage are very dangerous, and there is now no mark for them. For want of some such mark, scarcely a day passes without many vessels running a great risk of injury or loss.

The beacon of which I saw a draught in your room would undoubtedly stand; the plan combining great strength with little surface.

Any beacon put on the Rebecca shoals should be built, as the one you propose, with reference to its ultimate conversion into a light-house.

I would prefer, however, that the whole structure should be of iron, rather than part wood.

With a given strength, iron offers so much less surface to the wind or sea, and it is of so much greater durability, that the increased cost of iron is by no means commensurate with its advantages.

Very respectfully, your obedient servant,

JOHN RODGERS,

Lieutenant U. S. N., and Assistant Coast Survey.

F. H. Gerdes, Esq.,

United States Coast Survey.

APPENDIX No. 35.

Report of Lieutenant Commanding C. P. Patterson, United States navy, to the Superintendent of the Coast Survey, on buoys and beacons for entrance to Mobile bay.

Coast Survey Office,

August 20, 1849.

Sir: The following report upon the location, &c., for buoys and beacons for the entrance to Mobile bay is respectfully submitted:

Buoys.

1. A buoy, or, far better, a boat-buoy, with a heavy bell, just outside the bar, in eight and three-quarters fathoms, soft bottom, with Sand Island light-house bearing north 22° west, and distant from the bar one mile. A buoy is necessary at this place at all times, but much more so during the thick, hazy, and foggy weather, prevailing nearly through the most active season, when a bell would be of great benefit.

2. A buoy off the south end of West Bank, in twenty-five feet water, with Sand Island light-house bearing south 11° 30′ west, distant 1.78 mile, on a range of Mobile light-house, on West Umbrella Tree.

3. A buoy off the north end of West Bank, in forty-eight feet water, with buoy 2 bearing south 11° 30′ west, in range with Sand Island light-house, distant 1.68 mile, and Mobile light-house bearing south 55° 30′ east, distant 1 mile. The line joining buoys Nos. 2 and 3 will clear West Bank.

4. A buoy off the southwest end of Middle Ground, in twenty-five feet water, with Mobile light-house bearing south 28° 30′ east, distant 1.66 mile.

5. A buoy on the northeast edge of West Bank, opposite to the southeast end of the Middle Ground, with buoy 4 bearing south 42° 30′ east, distant 1.82 mile. The line joining buoys Nos. 3 and 5 will clear the northeast edge of West Bank.

6. A buoy on the twelve-feet spot (northeast end) of the Middle Ground.

7. A buoy on the southwest point of the spit, in nine feet water.

These buoys should be large, and of such construction as to be seen some distance; and of such form, and so colored, as to be known when seen in foggy weather, and to point out on which side they are to be passed. The system adopted for this purpose should be based upon the principles proposed by the late Lieutenant G. M. Bache, United States navy, in a report upon the buoys of Long Island sound.

Beacons—Entrance to Mobile Bay.

1. A beacon on Sand island, with the light-house bearing north 22° west, distant 245 feet. To cross the bar with beacon on the light-house.

2. A beacon on Sand island, with light-house bearing south 83° west, distant 145 feet, and beacon 1 bearing south 11° west, distant 250 feet, so that beacon 2, in range of beacon 1, shall clear the west bank.

3. A beacon on Revenue point, the south end of east bank. This beacon would bear nearly the same relation to this entrance that the "Rower beacon" bears to that of New York.

4. A beacon on Mobile point, with the light-house bearing south 34° east, distant 140 feet, near the water, and on the range of the black barrel over the chimney of the frame-house on middle of light-house; to lead through the channel between the southwest point of the Middle Ground and northeast edge of West Bank.

5. A beacon on Mobile point, with the light-house bearing north 46°

30′ east, distant — feet; and beacon 4 bearing north 16° 30′ east, distant 240 feet; so that beacon 5, on beacon 4, shall clear east bank, and beacon 5, on light-house, shall lead into the east end of Sand Island channel.

I would propose that beacons 1 and 4 have red lights, and beacons 2 and 5 white lights. Flashing and fixed lights would do better, but are more expensive. It would not be necessary to light beacon 3, and it would be an advantage.

It would not be required to see these beacons more than three-and-a-half miles; therefore, arcs of single reflectors (or, better, the Argand burner, with a single wick) would be sufficient; and they need not be over twelve or fifteen feet in height, made strongly, of rough wood.

Beacons 2, 3, and 5 should be black; beacon 2, because it would show against the sky, and to distinguish it from beacon 1, (as in red and white lights, flashed, &c.;) beacon 3, because it shows against the sky; beacon 5, because it shows against the sky, and to distinguish it from beacon 4. Red would probably be a better color than black. Beacon 1 should be black (or red) on the southeast side, as it would show against the white of Sand Island light-house, and white on the north side, to distinguish it from beacon 2. Beacon 4 should be white, as it would show against the green glacis of the fort, and to distinguish it from beacon 5. These beacons could be re-erected and kept lighted at a small expense, and no additional assistance would be required to the light-house keepers to keep them up. A buoy on the northwest end of the northwest Pelican shoal, and a beacon on Dauphin island, so placed that a bearing upon it would be the course into Pelican pass from outside, would be very useful to the mail-steamboats between New Orleans and Mobile during the winter months, when the north winds prevail, and the water is too low for them to use Grant's pass, the inside route.

At present the marks for this entrance are very inferior; those for the West Bank can scarcely be called such at all; and the mark leading through between the Middle Grounds and the northeast edge of West Bank is of the rudest kind, small, and during hazy weather can scarcely be seen, except with the sun to the westward. In foggy or thick weather, though knowing themselves off the bar, from the soundings and bottom, yet these cannot give their position with sufficient accuracy to allow the pilots to cross the bar, which a bell-buoy would enable them to do with great ease. The entrance to this bay, through which passes a yearly commerce of twenty millions, has no other marks or safeguards than the two light-houses, which are very inferior to the third order of French lights.

I would therefore respectfully urge the great necessity of calling the early attention of the department to these buoys and beacons.

I will merely state, that during the past year $40,000 worth of property has been lost on or near the bar, and $20,000 and upwards has been paid for salvage; and this, in the opinion of all, for want of good marks to clear the dangers.

These amounts I will forward as soon as they are obtained from the

agent of the underwriters at Mobile, who promised to forward them to me. The precise amount of loss and salvage, however, is over $60,000.

Very respectfully, your obedient servant,

C. P. PATTERSON,

Lieutenant Commanding, and Assistant Coast Survey.

Professor A. D. BACHE,

Superintendent United States Coast Survey.

APPENDIX No. 36.

Report of Lieutenant Commanding C. P. Patterson, United States navy, to the Superintendent of the Coast Survey, on buoys for Cat and Ship Island harbors.

COAST SURVEY OFFICE,

Washington, August 20, 1851.

SIR: The following report upon the location, &c., of buoys for Cat and Ship Island harbors is respectfully submitted:

1. A buoy just outside of Ship Island bar, in twenty-three feet water, hard, sandy bottom, with the west end of Ship island bearing north 53° east, to cross the bar in that course.

2. A buoy off the east end of Spade-fish shoal, (off north spit of Cat island,) in sixteen feet water, soft bottom, with Cat Island light-house just on with north point of north spit.

3. A buoy on northeast edge of Cat Island bar, with the west end of Ship island bearing north 66° east, distant six miles, south end of south spit of Cat island bearing north 71°, west, distant two and a half miles; and Sand Hill bearing north 5° west.

4. A buoy at the southeast end of Cat Island channel, in eighteen feet water, soft bottom, with south end of south spit bearing 11° 30′ west, distant one and a half mile; so that a course of south 71° west, distant two and one-fifth miles, between beacons 3 and 4, shall lead through the channel over the bar.

5. A buoy on the north side of Cat Island channel, near the northwest end of the mud-hole, eighteen feet water, hard bottom, with the south point of south spit bearing north 73° east, distant one and one-third mile; and Cat Island light-house bearing north 36° west, distant four miles.

6. A buoy off Potato Hill, with Cat Island light-house bearing north 5° west, distant two and a half miles. This buoy should be placed off the southwest point of Potato Hill, in eighteen feet water.

7. A buoy off the east end of Pistol shoal, in eighteen feet water, with Cat Island light-house bearing north 24° west, distant two and two-thirds miles; and the northwest point of Isle au Pied bearing south 42° east, distant one and two-thirds mile.

8. A buoy off the north edge of Pistol shoal, in sixteen feet water, with Cat Island light-house bearing north 52° east, distant three miles; and buoy No. 7 bearing south 71° east, distant one and a half mile.

9. A buoy off the west end of Pistol shoal, in eighteen feet water, with Cat Island light-house bearing north 52° east, distant four and a

half miles; and buoy No. 8 bearing north 70° east, distant one and a half mile.

The want of land-marks makes the necessity of so great a number of buoys.

The increasing commerce of the coast will, in time, demand greater facilities for navigation, in several beacons and an increased number of buoys; but the buoys named above are deemed sufficient for present purposes.

The importance of the channel south of Cat island, through which a large portion of the smaller trade to and from New Orleans must pass, and of Ship Island harbor, as one of refuge, will be strongly felt as this trade increases, which it is rapidly doing.

Very respectfully, yours,

C. P. PATTERSON,
Lieutenant Commanding, and Assistant Coast Survey.

Prof. A. D. BACHE,
Superintendent.

APPENDIX No. 37.

Letter of the Superintendent of the Coast Survey to James E. Saunders, esq., of Mobile, communicating sailing directions for Horn Island pass.

U. S. COAST SURVEY OFFICE,
Washington, May 27, 1851.

DEAR SIR: Upon the receipt of your communication of March 21st, I addressed letters on the subject to the assistants engaged on the Coast Survey in the locality embraced in your inquiries. Answers to those letters I have just received, and with pleasure communicate to you such information as the operations of the Coast Survey enable me to furnish. I wish that that information was more definite; but the hydrographical survey of Mississippi sound is as yet incomplete, and that at Grand bay has not yet been commenced. When the latter is made, it is possible, though not probable, that better water may be discovered in that bay than indicated by present information.

To pass through Horn Island pass, bring Round Island light-house to range about 150 yards over the east end of Horn island, and the woods on Petit Bois island to bear E. ½ N. There are here about four fathoms of water, whence a north course will take a vessel over the bar in not less than fourteen feet water, passing close to the spit of Horn island, (within 100 yards,) after passing three-quarters of a mile inside of Horn island, or until Round Island light-house bears WNW., stand east, (to avoid the shoal of La Grande Batture,) until the west end of Grand Batture island bears about N. by W. Along this line there are from eighteen to twenty feet water. A NNE. course will then take a vessel to the mouth of Grand bay; or a direct course may be made for Point aux Pines, until opposite the mouth of Grand bay, (the water gradually shoaling to eleven feet,) which lies between two spits, (bare at low water,) and is about three hundred yards in width. Across the bar, at the entrance

of Grand bay, nine feet water can be carried at high tide. Inside of the bar the water suddenly deepens to four fathoms, and thence gradually shoals to the mouth of Heron bayou, which, I presume, is the "creek" to which you refer. At the mouth of the bayou there are three feet at high water; but a continuous strong north wind will so depress the water in the bay as, at such times, to leave the mouth of the bayou bare at low water. There is no bar of hard bottom at its mouth, the whole being a muddy flat, through which scarcely any appearance of a channel can be traced.

There is no difficulty or danger in the navigation to the eastward of Grand Batture shoal, the bottom being smooth and even, (soft mud,) and shoaling gradually to "Isle aux Herbes." In beating against a hard wind between Grand Batture shoal and Petit Bois island, the lead will always indicate an approach to the shoal, which is of hard mud, while the bottom is elsewhere soft and sticky.

I trust that the preceding conveys the information sought by your inquiries, and shall be gratified if it prove to be of any service to you.

Yours, respectfully, &c.,

A. D. BACHE,

Superintendent United States Coast Survey.

James E. Saunders, Esq., *Mobile.*

APPENDIX No. 38.

Report of the Superintendent of the Coast Survey to the Secretary of the Treasury on light-houses in Galveston bay, with a report of Lieutenant Commanding Craven, United States navy, assistant in coast survey.

Coast Survey Office, *June* 17, 1851.

Sir: I have the honor to report in relation to the light-houses in Galveston bay, for which appropriations are made in the act of March 3, 1851, and in relation to which preliminary surveys have been required by the department. The lights are numbered 30, in the lists heretofore transmitted, and renewed in my communication of the 13th instant.

The three proposed lights are required for the navigation of Galveston bay; and their relation to each other is shown on the annexed chart by the positions marked "Half-Moon shoal," "Red Fish bar," and "Clopper's bar." The detailed charts show the locations more particularly of the lights at Clopper's bar and Red Fish bar, and the character of the navigation of the bay, the purposes of which they are to subserve. For details in regard to the lights I refer to the report of Lieutenant Commanding T. A. M. Craven, United States navy, assistant in the coast survey, which accompanies this report.

I concur with Lieutenant Craven in recommending a light-house as placed on the chart, at Clopper's bar; also in recommending a light-house placed as on the chart, at Red Fish bar. I am of opinion that the sites at Red Fish bar and at Half-Moon shoal should each be examined by a competent engineer, in reference to the doubts expressed by Lieutenant Craven as to the stability of the foundation, or that an ade-

quate guarantee should be obtained to secure the government against loss should a contract be made for the construction of these light-houses. If this examination, which should be accompanied by borings to ascertain the character of the substrata, should prove satisfactory in its results at either of the sites, or if an adequate guarantee should be obtained in regard to the structures, then I would recommend the construction of a light-house on screw piles at Red Fish bar, and at Half-Moon shoal. While the reasons given by Lieutenant Craven for placing a light-boat near Half-Moon shoal, instead of a light-house, show that caution is necessary, they are not, in my mind, conclusive against the construction of the light-house, as the shoal appears to be composed of sand and shells, and is in the interior of the bay.

Solid structures, which will obstruct the water way, are not at all adapted to the two upper positions in the bay.

The lights should be all of the harbor class. A small, fourth-order bay-light will suffice for each. The "light-houses" are required by law to be of the "third class." The lights need not be more than sixteen feet above the surface of the water to answer the purposes required of them.

Lieutenant Craven recommends the placing of a buoy off Dollar point, for which there is no appropriation yet made.

Very respectfully, yours,

A. D. BACHE,
Superintendent United States Coast Survey.

Hon. Wm. L. Hodge,
Acting Secretary of the Treasury.

Report of Lieutenant Commanding T. A. M. Craven, United States navy, assistant in the coast survey, to the Superintendent, in relation to light-houses in Galveston bay, Texas.

United States Schooner Morris,
Galveston Bay, May 13, 1851.

Sir: In obedience to your instructions of April 2, I have made an examination of Clopper's bar, Red Fish bar, and Half-Moon shoal, and send you a sketch of the bars on a scale of $\frac{1}{40000}$.

Half-Moon shoal I have laid down on a general chart of the bay of $\frac{1}{200000}$. As there is already a considerable trade carried on with the upper part of the bay, lights are very much needed at each of these points. I have to report as follows:

1st, Clopper's bar. At the mouth of San Jacinto river, on this bar, I found 4.5 feet, and it is situated at a point where the channel makes a very short bend. The bar is short, and of hard sand, a quicksand, liable to occasional shifts. I would recommend that a light of the third class be placed on the point of the sand spit, which I have marked "Light." At this point it would guide vessels clear of the shoal, making off from Mesquit knoll, and would also indicate the turn in the channel, as it should be situated so that vessels might pass it close on their port side.

The light-house should be built on iron piles, well sunk beyond the sand.

From this place to the Red Fish bar there are no obstructions, the soundings being very regular, eight and nine feet.

2d, Red Fish bar.—At this place a light is of such importance that there has been one placed here by private enterprise—the trading vessels paying an annual subscription. The light stands on the key indicated in the triangulation as "Middle Pass."

I would suggest that a light be placed on the east end of a small key, situated about two hundred and twenty metres ESE. of the present light. As you will perceive by the chart, a better range can be had for running through the channel than at present. On this bar there are at low tides 4.5 quicksand. There is better water in the channel SW. of the light-house, but the channel is so crooked and so very narrow that it is rarely used. The light-house on Red Fish bar should be on iron spikes, sunk to a good depth; and if the light has an elevation of twenty-five feet it will be quite sufficient.

The light at present there is not elevated more than eighteen feet above the water. I have made an examination of a shoal off Dollar point, on which there are three and a half feet water, and would suggest that a buoy be placed on its east side, in nine feet, which will give muddy bottom.

3d, Half-Moon shoal lies directly in the channel principally used by trading vessels and steamers; and I have found on it *one foot*. It is of small extent, and has a channel between it and the shore of *seven feet*. East of it the water is nine and ten feet, and very regular. This bank is composed of sand and *shells*. I would recommend that at Half-Moon shoal a small light-vessel be placed; a common bay sloop of forty tons would be sufficient. She should be coppered, as the worm is very destructive here; and her anchor should have but one fluke. She should be placed in ten-feet water, to the eastward of the shoal. The light placed at an elevation of twenty feet above the deck would be sufficient; and lights for each of these should be of the third class.

I recommend a light vessel at this shoal, as it is my belief that a light-house built here would be undermined by the current, and the sand, thus cut away, deposited in another place, thus rendering the light useless. I believe, too, that the same difficulty will be encountered in a permanent structure at Red Fish bar, where changes frequently take place, but am not prepared to say whether the substratum will give sufficient stability to the piles. I can best illustrate my meaning by calling your attention to the fact that the steamer wrecked in the channel several years ago (and the position of whose cylinder is given on the chart) was originally in five-feet water; the tides have cut away the sand to about twelve feet, all about the wreck.

Very respectfully, your obedient servant,

T. AUGS. CRAVEN,

Lieutenant Commanding, Assistant U. S. Coast Survey.

Professor A. D. Bache,

Superintendent United States Coast Survey,

Washington.

APPENDIX No. 39.

Report of the Superintendent of the United States Coast Survey to the Secretary of the Treasury, recommending a light-boat and buoy at Aransas Pass, and transmitting the report of the examination, by Lieutenant Commanding T. A. M. Craven, United States navy, assistant in the coast survey.

COAST SURVEY STATION,
Mount Pleasant, Maine, July 17, 1851.

SIR: I have the honor to report, in conformity with the law approved March 3, 1851, and the instructions of the department, that the examination of the necessity for a light-house at Aransas pass, Texas, has been made, and I enclose, herewith, the report of Lieutenant Commanding T. A. M. Craven, United States navy, assistant in the coast survey, the officer by whom the examination has been made, with the accompanying sketch of a reconnaissance of the locality.

It appears clearly, from this report, that the facility to navigation proposed in the appropriation bill is not "most suitable for the exigency which exists," but that it is expedient to place a light-boat of forty tons, with a harbor-light apparatus, instead of the light-house. Such a light-boat will subserve both the general and local wants of trade and navigation, and its position can be changed to accommodate it to the changing character of the entrance. The boat can be securely moored. I therefore recommend a suitable light-boat for Aransas pass, instead of the proposed light-house.

I would respectfully call the attention of the department to the fact stated by Lieutenant Commanding Craven, that there are no buoys in Aransas pass; also his views in relation to the position of the Galveston light-boat.

Very respectfully, yours,

A. D. BACHE,
Superintendent U. States Coast Survey.

Hon. WM. L. HODGE,
Acting Secretary of the Treasury.

UNITED STATES SCHOONER MORRIS,
Galveston Bay, June 21, 1851.

SIR: By the extraordinary inclemency of the season, I have been delayed in the examination of Aransas pass (as required by your instructions of April 1) until the last week.

I now enclose you my sketch of the pass, and have to report as follows:

From the frequent and rapid changes of the bar, (which I will indicate in this report,) I am of opinion that a light-house cannot be built at this place, in a suitable location, with any certainty of its standing five years.

The point in my reconnaissance, designated as "old range," was, in 1846, *within one hundred and twenty yards of the channel*, and the "range" itself was *a wash*. It is now three hundred and fifty metres from the

beach, and upwards of half a mile from the main channel. The "capstan" was planted in 1849 for heaving off a vessel which had grounded in this channel.

The point I have marked as "E range," was formerly a pilot's range, and fifteen months since was about fifty yards from the beach in the channel way; it is now three hundred and forty metres from the beach.

You will see from the above, that the point of St. Joseph has, for years, been making rapidly out to the southward, and as it encroaches on the channel, the opposite point of Mustang island wears away with equal rapidity. All of the point of St. Joseph, from the "old range" to the spit at the narrows, is a loose sandy flat, which has been entirely formed since 1846, and on which vegetation has commenced. I found an unusual depth of water on the bar—9½ to 10 feet—which may be accounted for by the strong and continued southeast winds of this season; ordinarily there are from 7 to 8 feet. The harbor is a good one, and is a place of some little coasting trade, there being one or two settlements up the bay.

I consider it of more importance as a *harbor of refuge* than as one of any present commercial advantage, and am of opinion that a light is very desirable at this place. A small light-vessel of *forty tons* and light draught may be anchored inside the south breakers, in 2½ fathoms, in good holding ground, and well sheltered from any storms, the bar forming a complete breakwater. A light of fourth class will be sufficient. The vessel should be well coppered.

I have to report that the buoys, which were placed on the bar, not having sufficient *chain*, have long since parted and gone adrift. There are at present no channel marks whatever.

The soundings on the sketch are expressed in *feet*, as there is much irregularity of bottom. I have thus guarded against mistakes.

The breakers are long spits of sand which are constantly changing with every storm, so that ranges for running in are altering every five or six months.

In connexion with this subject I have to report, that after a careful examination of the matter, I may say, confidently, that the light-ship at Galveston, in her present location, is of scarcely any use to sea-going vessels. She is anchored nearly *three miles inside the bar*, and knowing the approaches as well as I do, I consider it unsafe to run for it at night, because of the difficulty of seeing the light at a safe distance outside; and, in consequence, a sailing vessel not "having hold of the light," cannot ascertain her position, and having no guide to her movements, is liable to be swept to the southward and westward by the current.

I know that it has been urged that the present location of the light-vessel is of great advantage to coasters, as being at the junction of the three channels.

The coasting trade, however, is small, and is carried on in vessels not exceeding four or five feet draught. These vessels alone, save one or two steamers of light draught, use the south channel; they could, most of them, run over any part of the shoal forming the bar without danger; the sea steamers use the main channel; the north or cylinder channel is only used by two or three small craft trading with the Sabine,

and which might safely pass anywhere over the shoals. These coasting vessels, therefore, hardly require a light, particularly where, in giving it to them, the interest of the external commerce suffers.

Very respectfully, your obedient servant,

T. AUGS. CRAVEN,

Lieut. Com., Assistant U. S. Coast Survey.

Prof. A. D. Bache,

Superintendent U. S. Coast Survey, Washington, D. C.

APPENDIX No. 40.

Tribute of respect to the memory of Lieutenant Commanding Wm. P. McArthur, United States navy, assistant in the coast survey.

Intelligence having reached Washington city of the death, at Panama, on the 22d December last, of Lieutenant Commanding Wm. P. McArthur, United States navy, assistant in the coast survey, the civilians and officers of the army and navy on coast survey service met at the office on Wednesday, February 8, 1851, to pay the tribute of respect due to his memory.

The meeting being called to order,

On motion of Lieutenant Chas. H. McBlair, United States navy, seconded by Lieutenant Maxwell Woodhull, United States navy, Alexander Dallas Bache, LL. D., Superintendent, was called to the chair, and Lieutenant Thornton A. Jenkins, United States navy, appointed secretary.

Professor Bache addressed the meeting as follows:

We are met here, as you all know, to pay a melancholy tribute of friendship and respect to one who was dear to us all—dear as a brother to many of us. Instead of greeting his arrival among us, as we had fondly hoped, in health—in the full flush of success—we meet to mourn over his loss from our band.

The work which he accomplished will live forever. Surrounded by circumstances the most difficult, perhaps, which ever tried the constancy, the judgment, the resources of any hydrographer, he vanquished circumstances. His reconnaissance of the western coast, from Monterey to Columbia river, and his preliminary survey there, were made in spite of desertion and even mutiny—in despite of the inadequacy of means to meet the truly extraordinary circumstances of the country. Happy that in his officers he had friends devoted to him and to their duties—especially happy in the officer next to him in the responsibilities of the work.

Prostrated by an attack of fever of a malignant type, contracted while preparing his vessel for sea, Lieutenant McArthur, nevertheless, persisted in volunteering for the charge of a hydrographic party on the western coast. A subsequent relapse did not abate his determination to enter as a pioneer upon this arduous service—trying alike to his powers of mind and body. Steady in the midst of excitement, he laid his plans in the way to command success. Seizing the peculiar wants of the hydrography of that coast, he applied all his energies to supply

them. The gratitude of his fellow-citizens, then, is already his—the praise of the new country, the resources of which he has aided in developing. He has been called away just as his wishes were realized, ample means furnished, and the worst difficulties overcome. In his letter and report he urged strongly the necessity for enlarged appropriations, and for a steam vessel for the hydrography. The last letter from this office brought him news that both his wishes were gratified, and called him home to make the enlarged arrangements for continuing his work. The arrival of Mr. Cutts, with instructions as late as the beginning of October, confirmed the necessity of his return, and he took passage in the steamer Oregon, commanded by his friend, Lieutenant Patterson. An attack of dysentery prostrated him completely, and from this, in spite of the best medical attendance—of such nursing and attendance as only the circumstances to which I referred could insure—he rallied but for a time, and sank to his final rest before he could be landed at Panama. His remains were consigned to a foreign soil, to be brought, let us hope, to his country, where all his affections centred.

He has not lived in vain. His name will ever be bright in the annals of our survey—whether in the more usual labors on the Atlantic coast, or as the pioneer on the shores of the Pacific—always advancing as life advanced—the last his crowning work.

Professor Bache having concluded his remarks, Lieutenant Washington A. Bartlett, United States navy, arose and said—

Mr. Chairman and gentlemen: After the appropriate and feeling remarks of the chairman, it is unnecessary for me to add more than to say that when I left Captain McArthur on the western coast he was in excellent health and buoyant spirits, in view of what had been done, and what he hoped yet to accomplish. It was my good fortune to be long associated with him, and that association caused me to love him as a brother. I will not detain you, but offer the following resolutions for your consideration:

1. *Resolved*, That the civilians and officers of the army and navy engaged in the United States Coast Survey, now assembled in Washington, have received, with feelings of deep emotion, the melancholy intelligence of the death of Lieutenant Commanding Wm. P. McArthur, United States navy, assistant in the coast survey; and that, in his sudden and unexpected decease, the navy has lost one of its most gallant and accomplished officers, and the coast survey one of its most zealous and efficient laborers.

2. *Resolved*, That the successful reconnaissance of the western coast of the United States, from Monterey to Columbia river, and the preliminary survey of the entrance to the Columbia—accomplished under the most peculiar and extraordinary difficulties—while they are proofs of his unconquerable energy, determination and skill, have forever identified the name of Wm. P. McArthur with the progress of the republic in the West.

3. *Resolved*, That we most sincerely sympathize with the bereaved and afflicted family of our generous and warm-hearted friend in their irreparable loss, and commend the widow and orphans to the gratitude of the republic, to whose service the husband and father was so ardently devoted throughout his life.

4. *Resolved*, That Professor A. D. Bache, Superintendent United States Coast Survey; Brevet Major J. J. Stevens, United States Engineers; Lieutenant M. Woodhull, United States navy; Mr. J. J. Ricketts, United States Coast Survey; and Passed Midshipman R. M. Cuyler, United States navy, be a committee to take the necessary measures to have erected, in the Congressional Burying Ground, a suitable monument, commemorative of the services and virtues of the deceased.

5. *Resolved*, That a copy of these resolutions be communicated to the Navy and Treasury Departments, with a request that they be placed on the files; and also to the family of the deceased; and that they be published.

6. *Resolved*, That the officers of the coast survey will wear a badge of mourning for thirty days, in further testimony of their regard for the memory of the late Lieutenant Commanding Wm. P. McArthur.

Major Stevens, in seconding the resolutions, addressed the meeting as follows:

I rise, Mr. Chairman, in the name of one of the co-ordinate services associated on duty here, to pay a tribute to the memory of Lieutenant McArthur. I can add nothing to the remarks that have already been made. I simply propose to pay a tribute of feeling and respect.

It was not my fortune to know Lieutenant McArthur personally, but I feel that I know him through his works. They hold up his character as worthy of all respect and admiration. In prosecuting his labors on the Pacific shore, he exhibited a constancy, an energy, and a rare force of command, which enabled him to triumph over almost insuperable difficulties. These qualities would have made him conspicuous in any career. He possessed all the elements of the heroic spirit. Trials which bowed down the strength of strong men, gave his feeble frame almost superhuman strength; and he accomplished, in the midst of sickness and physical depression—of mutiny and desertion—labors that those most highly favored by health and appliances would have shrunk from. His example appeals to us with irresistible force. How can we yield to despondency, witnessing his lion heart accomplishing its great purposes—giving vigor to a worn-out frame, and snatching success from the elements of defeat.

McArthur was an ornament to both services with which he was connected—to that larger service, the profession of his youth, in which he took such pride, and that other service, to which his maturer years have been applied. He has, in the words of the resolution, forever identified his name with the progress of the republic in the West. It has gone into history, and will henceforth be associated with those of Decatur and of Perry.

The resolutions having been agreed to unanimously, the meeting adjourned *sine die*.

A. D. BACHE, *Chairman*.

THORNTON A. JENKINS, *Secretary*.

APPENDIX No. 41.

Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, showing the most suitable site for a light-house at Point Conception, California.

COAST SURVEY OFFICE,
March 13, 1851.

SIR: I transmit herewith a sketch of Point Conception, California, furnished by the officer of the coast survey on that coast, for the purpose of showing the most suitable site for a light-house in that vicinity.

This is a steep, rocky point, projecting into the sea, 240 feet high; at the point selected for the site of the tower 286 feet broad, 533 feet to the pitch of the point; and the whole length of the projection 832 feet.

It has been ascertained, by a careful examination and inquiry, that the point Arguillo, to the northward, is not the best location. All who have been consulted on the subject agree in recommending the point marked on the sketch ⊙ as the best position for the light. It will be seen from the accompanying tracing of the coast of California, on either side of Point Conception, that it *trends* about NW. and SE. A first-order seacoast light, with a lantern thirty or forty feet from the base of the tower, will be seen, under ordinary circumstances, twenty-five to twenty-eight nautical miles from the deck of an ordinary merchant vessel.

It is deemed highly important that this should be a light of the first order, according to the European classification, illuminating two hundred and eighty degrees of the horizon, to subserve all the purposes of navigation.

The light on Point Conception should be made a revolving or flashing light, to enable the proper distinctions to be made in those on either side, and nearest to it.

Very respectfully, yours,

A. D. BACHE,
Superintendent U. S. Coast Survey.

HON. THOS. CORWIN,
Secretary of the Treasury.

APPENDIX No. 41, *bis*.

Report of the Superintendent of the United States Coast Survey to the Secretary of the Treasury, on the latitude and longitude of Point Conception, California.

COAST SURVEY OFFICE,
March 22, 1851.

SIR: The latitude of the coast survey station at Point Conception, California, has been determined from observations by Assistant George

Davidson, to be 34° 26′ 56″ north, and the longitude 120° 25′ 6″, or in time 8*h*. 01*m*. 43*s*. west of Greenwich Observatory.

Yours, very respectfully,

A. D. BACHE,
Superintendent U. S. Coast Survey.

Hon. W. L. Hodge,
Acting Secretary of the Treasury.

APPENDIX No. 42.

Letter of Superintendent of Coast Survey to Secretary of Treasury, communicating a report of A. M. Harrison, esq., sub-assistant in coast survey, on a site for a light-house on Point Pinos, near Monterey, California.

Coast Survey Office,
March 14, 1851.

Sir: I have the honor to transmit herewith a sketch of Point Pinos, near Monterey, California, the site recommended in the accompanying report for the light-house near Monterey, for which an appropriation was made at the 1st session of the 31st Congress. I concur in the recommendations contained in the report. The choice of the site, between the three points designated, might be left to the engineer charged with the construction of the light-houses.

Very respectfully, yours,

A. D. BACHE,
Superintendent U. S. Coast Survey.

Hon. W. L. Hodge,
Acting Secretary of the Treasury.

Camp, Point Pinos, near Monterey, Upper California,
January 28, 1851.

Dear Sir: This report accompanies a tracing of the plane table map of *Point Pinos*, including the extreme end of the point and the vicinity towards Point Cypress on one side, and Monterey on the other, on a scale of $\frac{1}{10000}$. It gives the ground in the region of the most suitable position for a light-house, showing its character, elevation, &c.

Point Pinos is a pine-covered, rock-bound projection of land, extending in a NW. direction from Monterey to the distance of about three miles, rising gradually from the water's edge, and, from its position, affording complete shelter from the SE. winds to vessels at anchor off the town. The whole shore of the point from near Monterey to Point Cypress is very rocky, and, except in the calmest weather, there is a heavy surf from the swell of the ocean, rendering a landing in the boats exceedingly dangerous, if not impossible.

I have marked upon the tracing three positions, (*a*, *b*, *c*,) in each of which a light-house may be placed, each having its advantages.

(*a*) as shown in the tracing, is in the pines, its advantage over the other two being its elevation; but, in order to be seen to the seaward, and by vessels leaving the harbor, it will require a great deal of clearing. The ground is sandy and pretty firm.

(*b*.) This position is in the small sand-hills. The site commands a fine view to seaward, and requires little if any clearing.

Judging from the nature of the point, it is to be presumed that beneath the sand there is a rocky substructure for a foundation, although it may be at a considerable depth.

(*c*) is the level surface of the rocks, covered with wild shrub. Its foundation is good, but it is cut off from the main shore at high-tide; the distance being 103 metres (112.6 yards.) The islet is about 80 square metres (95 square yards) in area, and about ten feet above high-water mark. The main objections to it, as a site for a light-house, consist in its small size, its isolation from the main-land at high tide, and an uncertainty as to how long it will stand the force of the sea. It is exposed to the full violence of all seaward winds, and many of the rocks in the vicinity have been undermined and have fallen. It is also possible that in severe gales the sea washes over it.

The distance at which the light from the lantern of a light-house 40 feet in height would be visible if placed on

(*a*) would be....................................13 miles.
(*b*).....do.......................................11 "
(*c*).....do....................................... 9 "

The sector of visibility of the light from seaward would be 110° from the south, round through the west, to north.

The line (x) shows the general run of the shore towards Monterey, and (y) towards Point Cypress.

I have before spoken of the difficulty of landing on the point, but the town is only about three miles distant, and there is a good road running to the end of the point.

Fine spring-water can be obtained in the immediate neighborhood, and the land is sufficiently rich for the purposes of cultivation almost anywhere on the western side of the point.

There is a quarry of coarse limestone near the town, but whether suitable for building purposes or not I am not informed.

If it is proposed to erect a fog-signal here, (and the fog is very frequent and thick in the winter,) there are many places on the rocks equally suitable for the purpose, as may be seen by a reference to the map. I have inserted the true and the magnetic meridian—the former given me by Assistant Davidson, and the latter obtained approximately by the compass attached to my plane table.

Very respectfully, your obedient servant,

A. M. HARRISON.
Sub-Assistant U. S. Coast Survey.

Prof. A. D. Bache,
Superintendent U. S. Coast Survey, Washington, D. C.

APPENDIX No. 43.

Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, recommending a light-house at Point Loma, near San Diego, California; with the report of Sub-Assistant A. M. Harrison on the same.

COAST SURVEY OFFICE,
November 22, 1851.

SIR: In conformity with the instructions of the Treasury Department, I have caused a survey to be made for the sight of a light-house at Point Loma, near San Diego, California, for which an appropriation was made by act of Congress approved September 28, 1850. I send herewith a sketch, showing the locality proposed for the light, and its relations to the harbor of San Diego and its approaches; also, a sub-sketch, on a large scale, giving the character of the site more in detail. In a few weeks an engraved harbor chart of San Diego will be transmitted, to take the place of these sketches, or as supplementary to them.

The light which is recommended is one of the first order, or a sea-coast light, to be placed on the bluff in the position marked, in a tower (say) twenty feet high. The range will thus be 31.7 statute miles, and the light will be visible beyond the Coronados, and over a sector of the horizon of about 187°.

A small harbor-light is further recommended on Ballast point, at the place marked in the sketch, as a leading light up the bay. Its elevation may be fifteen feet.

I append the report of Sub-Assistant A. M. Harrison, by whom the plane table survey of Point Loma was made. The survey of the harber was made by Assistant R. D. Cutts, of the coast survey.

The considerable height of the point at which this light-house is to be placed induced me to withhold the report of Mr. Harrison, and any recommendation concerning it, until I had consulted him as to the probability of interference from fog. He reaffirms his opinion of the propriety of the site, after considering this objection.

In recommending lights for the western coast, I have not advised that any of them be revolving lights, except in the case of Point Conception, conceiving that at present, until facilities for repairs of machinery and the number of lights are increased, it is inexpedient and unnecessary to resort to such a distinction.

Very respectfully, yours,
A. D. BACHE,
Superintendent United States Coast Survey.

Hon. THOMAS CORWIN,
Secretary of the Treasury.

LA PLAYA, NEAR SAN DIEGO, CALIFORNIA,
June 2, 1851.

DEAR SIR: This report accompanies a tracing from the plane table map of the bay of San Diego, including Point Loma, the proposed

light-house site, and La Playa, (the *port of San Diego*,) on a scale of $\frac{1}{10000}$.

Point Loma is a long, narrow strip of land, extending in a southerly direction about $2\frac{3}{4}$ miles from the Playa, and is composed of a chain of abrupt and broken hills, varying from 200 to 400 feet in height, cut with deep, narrow, and in many places precipitous gorges. On the western side the shore is perpendicular, and varies from twenty-two to ninety feet in height; while on the eastern shore of the Playa to Ballast point, (a narrow low spit, formed of large pebbles, running out from Point Loma, and forming the western side of the entrance,) the shore is bluffy, and not generally as high as the opposite one. To the south of Ballast point the shore is still bluffy, and increases gradually, until it reaches the extreme point. At this place the hills jut boldly upon the sea, forming a very steep bluff, three hundred feet in height. The hills are composed mainly of coarse modern sandstone, and are covered with a growth of low bushes, red wood, and artemisia, interspersed with three or four varieties of cactus. Landing is practicable, in calm weather, at almost any part of the point; but the hills are so precipitous that it would be almost impossible to transport any building materials up their sides.

The position for a light-house, which I have marked upon the chart by a red circle, I recommend for the reason of its superior elevation, the large view it commands to seaward, its good foundation, and its level surface. It is four hundred and twenty-two feet high.

The distance at which the rays of light would touch the horizon of the ocean from a light-house twenty feet high, located at this site, would be thirty-two and four-tenths statute miles.

It commands an extent of horizon to seaward of 187°. In erecting a light-house on this point, the materials should be landed at the Playa, and then could be easily carried to the point along the top of the range of hills. There is a path extending the whole distance, and, with a little cutting of the bushes, it could be made practicable for mules. It would be necessary to bring the materials for building purposes from some other port, as there is nothing in this region which could be turned to advantage.

There is no water nearer than San Diego, five miles distant from the Playa. It is obtained from San Diego river, and brought down in casks. Some men are at present boring an Artesian well at the Playa, but success is very doubtful. The land is not favorable for cultivation.

The entrance to the bay is so narrow, and Ballast point is so low, that I think a secondary light on the end of it would be advisable. The extremity of the point is composed of large, round pebbles, similar to our paving stones, and the foundation is quite hard. I have marked the point upon the tracing.

Since our stay here, fogs have been frequent and heavy, and I think it would be advisable to place a fog-signal upon the bluff at the end of the point. If it is to work by the action of the waves, it could be

placed upon a reef running S. by W. from the end of Point Loma, where there is always a swell, even in the calmest weather.

Respectfully submitted.

A. M. HARRISON.

Professor A. D. Bache,
Superintendent United States Coast Survey.

APPENDIX No. 44.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, transmitting the report of Sub-Assistant A. M. Harrison, of a survey of Cape Disappointment, or Hancock, for location of a light-house, and communication of Lieutenant Bartlett, U. S. N., assistant in coast survey, on same subject.

Coast Survey Station, near Alfred, Me.,
September 29, 1851.

Sir: I have the honor to transmit, in pursuance of the instructions of the department, a minute survey of Cape Disappointment, or Hancock, at the entrance to Columbia river, Oregon, for the location of the light-house for which appropriations have been made. To the report and sketch of Assistant A. M. Harrison I add a proof-sheet of the preliminary survey of the entrance, to show in a general way the localities referred to. I have also annexed a report by Lieutenant Bartlett, U. S. navy, assistant in the coast survey, in relation to this same light, which contains suggestions in reference to the kind of structure to be erected there. I approve the recommendations of Assistant Harrison of the site marked ⊙ on his map for the light-house, and of the elevation of forty feet, which he proposes for the light. It should be a seacoast light of the first class, and will be visible nearly twenty-five miles.

I would recommend that so much of the adjacent woods should be removed as will render the establishment secure from the near approach of fire.

Very respectfully, yours,
A. D. BACHE,
Superintendent U. S. Coast Survey.

Hon. Thomas Corwin,
Secretary of the Treasury.

U. S. Coast Survey Station, Cape Hancock,
Mouth of Columbia River, Oregon, July 28, 1851.

Dear Sir: I send with this report a tracing of Cape Hancock, or Disappointment, on a scale of $\frac{1}{10000}$. It embraces the proposed light-house site and three miles of the shore. Cape Hancock, forming the northern point of the entrance to Columbia river, is a bold, narrow promontory of basaltic rock, projecting into the sea in a curve from the north around by the west to the south.

The extremity of the cape is formed of a range of hills, varying from one hundred and fifty to two hundred and eighty feet in height, generally narrow at the summits. On the outer faces these hills are covered with rank, high, thick grass and weeds, and slope abruptly to different heights; then, falling perpendicularly, present to the ocean an irregular wall of rock, intersected at one or two points by deep inlets, into which the sea flows during flood tides. On the inner side the slope is more gradual, but in most places also steep, and from the top of the ridge down to the water's edge, covered with tall pines, and a dense and occasionally impenetrable undergrowth of bushes ; the *salmon berry*, fern, and *salal* being the principal kinds. The soil is rich, and covered to the depth of a foot, and in some places more, with a light, yielding carpet of decayed and decaying leaves and branches, the annual deposite of the trees and bushes above.

The cape forms the western shore of Baker's bay, which affords good anchorage in six and three fathoms.

The position which I think most advisable for the location of a light-house, and which I have marked upon the tracing by a black circle, I recommend for the following reasons:

Height. Although ninety-five feet lower than the hill upon which the observatory is situated, (which is the highest on the end of the cape,) I think it has the advantage from the fact that the fog banks, during their prevalence, frequently, and in fact generally, rest upon and above the summits of the most elevated hills ; while those below are clear and unobscured. So I am informed by persons who sail in and out of the river. Light-house hill is one hundred and ninety-two feet high ; Observatory hill two hundred and eighty-seven feet.

Command to Seaward. The angle commanded to seaward by a light placed as recommended would be much greater than one on Observatory hill, unless the government chose to go to the expense of time and money in felling a large quantity of trees to the northward, and those, like all trees of Oregon, of no ordinary size. A person standing on the proposed site commands a view to seaward of one hundred and thirty four degrees.

Form. Upon the summit it is broader, and would require less digging and grading to secure a sufficiently large foundation. In fact a light-house could not be erected upon the narrow top of Observatory hill without a great deal of trouble and expense on this account. In digging I find stone at the depth of two feet.

The best point at which to land materials for building purposes is the little cove I have marked ("a") upon the tracing. A road which was cut for carrying up the observatory would suffice to get upon Observatory hill; but the path between the Observatory and Light-house hill runs along a narrow ridge. I have marked it upon the tracing by a black line. I think it would be advisable to cut a road directly from the cove to Light-house hill, a distance of about 440 metres (481 yards.)

The cove ("a") in which our camp is pitched is a good position for a house, being, by the present path, fifteen minutes' walk from Light-house hill. A spring of fine water runs in a continual stream from the rocks, a few metres from camp, and there is sufficient ground for a

small vegetable garden. A house once stood here, but was destroyed by fire.

The site for a city has been laid out about two miles from the point, under the title of Pacific city.

The house which you see upon the tracing was erected by the Hudson's Bay Company, and is occupied by a half-breed and his family. He has quite a good garden.

The distance at which a light, forty feet high, located at the site, would be visible, is twenty-five statute miles, nearly.

Respectfully submitted by your obedient servant,

A. M. HARRISON,
Sub-Assistant Coast Survey.

Prof. A. D. Bache,
Sup't U. S. Coast Survey, Washington.

Report of Lieutenant Washington A. Bartlett, United States navy, assistant in coast survey, to the Superintendent, in relation to a light-house at Cape Hancock, or Disappointment, entrance to Columbia river.

Washington, *November* 29, 1850.

Sir: In answer to your inquiries as to the character of the light-house which should be erected at Cape Hancock, or Disappointment, at the mouth of the Columbia river, Oregon Territory, and for information as to the locality on which it should be placed, &c.—

I have the honor to state, that Cape Hancock, or Disappointment, at the mouth of the Columbia river, Oregon Territory, where it is proposed by a late act of Congress to erect the principal light-house for that river, is a bold cliff of columnar basalt, rising perpendicularly from the sea to variable heights of from two hundred to three hundred feet, terminating in unequal rolling summits, covered with a rich and fertile soil.

The summits vary also in width from ten to fifty feet at the apex, whence they slope by a quick descent to the northward; the northern or in-shore face of the hills being covered by a dense growth of gigantic pine, alder, and other trees, with a thick growth of vines, "salmon berry," and other shrubbery.

The summit of the sea cliffs (which are not covered by the forest) is the proper position for locating the light-house; say within two to four hundred yards to the westward of "Broom station," as given on our triangulation of the river. Should the tower be placed there, it will show the light from the lantern around three-fourths of the horizon without the necessity of felling the trees to the northward.

In this position the base of the tower will be about two hundred and fifty feet above high-water mark; and should the tower be raised forty feet to the deck of the lantern, (and in my opinion it should not be less,) on a base of sixteen feet in diameter, it will be a prominent landmark for making the cape in the daytime.

The lantern, or light, which is to be placed on the tower should be of a power not less than the best light on Navesink; in other words, a marine light of the first power.

The tower should be constructed of fire-proof materials, and no wood whatever should be admitted into the construction of the building, as there is at all times much danger of the forest being fired to the northward, which, in such case, would inevitably destroy the building.

From the cove in Baker's bay, where the materials would be landed, the distance is about one thousand yards by a path, now greatly obstructed by huge trees, which have fallen across it. It must ever be a difficult matter to transport any great amount of bulk, or weight, to the summit. A good road must first be made. Whether the tower is constructed of wood, iron, or brick, the materials must be transported in small parcels.

When such a tower as I have contemplated is lighted up by a light of the first power, it will be clearly visible for a distance of nine leagues at sea, from the northwest by the west, and southwest to the south, and by the east for the entire width of the river, and for the same distance up the Columbia.

A light on Cape Hancock, or Disappointment, will be of vast importance to the rapidly increasing commerce of Oregon, as it will enable all vessels to approach the coast boldly, and then to maintain their positions on pilot-ground until daylight, when they will be at once taken into port by the highly intelligent pilots now fully established there.

Very respectfully, sir, I have the honor to be your obedient servant,

WASHINGTON A. BARTLETT,

Lieutenant United States Navy, Assistant Coast Survey.

Prof. A. D. Bache,

Sup't U. S. Coast Survey.

APPENDIX No. 4.

Extracts from a letter of Lieutenant Commanding James Alden, U. S. N., assistant in the coast survey, to Professor A. D. Bache, Superintendent, relating to Humboldt harbor and Trinidad bay, California.

U. S. Surveying Schooner Ewing,
San Francisco, August 31, 1851.

Dear Sir: * * * * * * *

We left San Francisco on the 24th of June, and after an exceedingly boisterous passage of ten days arrived at Trinidad. This anchorage is, during six months of the year, perfectly safe and comfortable. It is some twenty miles to the northward of the entrance to Humboldt; and, as the wind was unfavorable for us to go there at the time, we employed ourselves during the detention of two or three days in making a chart of the bay. It is sent with the others, and I hope it will meet with your approbation. The mines in the vicinity of Trinidad have made it quite an important location. It serves as a resting place for the miners, and is the source whence all their supplies are derived.

There are about one hundred houses in the village, and the land in the vicinity, for agricultural purposes, can hardly be surpassed. The

gigantic red wood abounds there in all its magnificence, always affording to the hardy settler the readiest and most lasting material for neat and appropriate buildings. The fibre of this wood is so straight, and so easily separated, that it is split with comparatively little trouble into all the different forms requisite for an unpretending dwelling in a new country. The depredations of the Indians in that quarter have been, I am sorry to say, a serious drawback to their farming operations; so much so, indeed, that most of them have been compelled to leave their all and go into the town for protection.

On the 10th July we left Trinidad with a fair wind, and in a few hours were at anchor in Humboldt bay. We were employed about four weeks in making the survey of that place. Finding it much better in every respect than it had been represented, I gave it more care and made a closer examination than an ordinary reconnaissance required.

* * * * * * * *

This body of water partakes more of the character of a lagoon than an ordinary bay. It is sixteen miles long, and from one to five broad. It is broadest at either extremity, where it is but a great grassy flat, washed with about one foot of water, (when the tide is out,) and broken here and there by navigable sluices. The entrance is practicable, except in very bad weather, when the sea breaks entirely across it. There are twenty-one feet on the bar at low water, and the ordinary strength of the tide does not exceed two knots. Under unfavorable circumstances, at low water, and with a very light breeze blowing directly in the channel, this schooner went to sea without difficulty. The two sea walls, or narrow necks of land, which so nearly shut out the sea, are covered with sand-hills, ranging from ten to forty and fifty feet in height. On the north spit I have marked the place where I think the light-house should be located. It is the nearest point to the entrance, and is, therefore, less liable to be obscured by fog; and with a beacon farther back, the two would form the best range to pass between the north and south breakers—not that it should be attempted at night, unless under the most favorable circumstances. As Humboldt is rather out of the way of vessels passing up and down the coast, I have thought that a light of the second or third class would answer all purposes required at that point, and be sufficiently large for vessels bound in to maintain their position during the night. The country is hilly, almost mountainous, in the vicinity of Humboldt. The fir and the red wood predominate in the forests, and I am informed that the land possesses every requisite for farming purposes. The cattle luxuriate the year round in green grass and the tallest clover I ever saw. The temperature is very equable; they have a slight frost in the fall, and the winter only differs from the summer in being more pleasant. Elk and deer are found in abundance, and many varieties of wild fowl frequent the bay. There are no less than four villages or settlements on the bay. Humboldt, at the entrance, has thirteen houses; Eureka as many. Bucksport is just taking a start, and its location is thought to be superior to all the others, from the fact that it has better water and more room for commercial purposes. Union town is the largest, having about one hundred houses. It is located in the north end of the bay. Its proximity to the mines is the only advantage it has over the others

while the difficulty of transporting supplies from the depot at Eureka seems to be almost an insurmountable objection to its ever becoming a place of much importance. Everything has to be carried in small boats up a very narrow sluice, and that only at high water, while the nearest point of water communication is a mile from the town. A road can be cut from either of the other towns to communicate with the one from Union to the mines, with but little expense or trouble.

I am, sir, very truly and respectfully, yours, &c.,

JAMES ALDEN,
Lieut. Com'g. U. S. N., and Assistant Coast Survey.

Prof. A. D. Bache,
Superintendent U. S. Coast Survey.

APPENDIX No. 46.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, transmitting the report of R. D. Cutts, esq., assistant in the coast survey, with sketches of his survey of Fort Point, at the entrance to San Francisco bay, and of Alcatraz, or Bird island, within the bay, proposed as sites for light-houses.

Coast Survey Office,
February 13, 1851.

Sir: I have the honor to transmit a report by Assistant R. D. Cutts, of the Coast Survey, with sketches of his survey of Fort Point, at the entrance to San Francisco bay, and of Alcatraz, or Bird island, within the bay, proposed as sites for light-houses in the bill passed at the last session of Congress. The complete drawings which Mr. Cutts forwarded by Adams & Co.'s express have not come to hand, but the report and sketches of the sites, with a tracing from the chart of the bay, which shows the relative positions of the points, will supply the information essential to the action of the department. When the complete drawings are received, I will replace these and sketches by copies of them.*

I have examined, and confirm, the recommendations made by Mr. Cutts in his report; nor have any facts come to my knowledge from inquiries made of Lieutenant Patterson, United States navy, formerly attached to the Coast Survey, who has commanded the mail-steamer Oregon, plying on the western coast, of Lieutenant Bartlett, recently engaged in the hydrography of the western coast, and of Passed Midshipman McLane, second officer of the mail-steamer "Panama," and recently attached to the Coast Survey, to indicate that the location already adopted for lights at the entrance of San Francisco bay (the South Farrallone, Fort Point, and Alcatraz island) should be altered.

I respectfully recommend for the light on Fort Point one of the sec-

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* The drawings were subsequently sent in.

ond order, (French system,) or its equivalent; and for the one on Alcatraz island one of the fourth order, or its equivalent.

Very respectfully, yours,

A. D. BACHE,
Superintendent U. S. Coast Survey.

Hon. Thos. Corwin,
Secretary of the Treasury.

San Francisco Bay,
December 27, 1850.

Dear Sir: In conformity with your instructions of October 5, directing that light-house surveys should be my first and immediate duty upon arriving at San Francisco, I have to report that I have made the necessary examinations and surveys of Alcatraz island and Fort Point, in the Bay of San Francisco, the results of which, and sketches on a scale of $\frac{1}{10000}$, are herewith forwarded.

The magnetic course of Alcatraz island from Fort Point is N. 53 E., say NE., by E. which is the best range for crossing the bar and for passing between Points Lobos and Boucta. The Farrallones are visible from Alcatraz. The three localities, therefore, appear to be well selected; and when the lights are erected, every desirable object will be accomplished.

Alcatraz, or Bird island, is a large rock, rising to an elevation of one hundred and thirty-five feet above high-water mark. Its greatest length and breadth are one thousand six hundred and seventy-three, and five hundred and ninety feet, respectively. The summit is rounded, and has a thin layer of soil, the rock itself being soft, friable, and easily excavated; deep water-marks all around the island, and, with the exception of at two or three particular places, the sides are so precipitous that a landing can be with difficulty effected.

Fort Point is sixteen thousand seven hundred and ninety-eight feet, or three miles three hundred and nineteen yards, from Alcatraz island, and commands a full view of the entrance to the bay. The proposed site for the light-house is on an elevated and prominent point, (one hundred and seven feet above high-water mark,) and which was formerly occupied as a Mexican fort.

The sites for light-houses are marked on the sketches by a circle in red ink.

Fort Point belongs by reservation to the United States. Alcatraz is claimed by purchase from Mexican grants by Col. J. C. Frémont.

Table.

	Height of lantern above base.	Height of base above high-water mark.	Height of lantern above high-water mark.	Distance at which lights would be visible, clear weather, nautical miles.	Statute miles.
Alcatraz island .	20 feet.	135 feet.	155 feet.	17 miles.	21
Fort Point	20 "	107 "	127 "	15 "	19½

I am, &c., yours, truly,

RICH. D. CUTTS,

Assistant Coast Survey.

Prof. A. D. Bache,

Superintendent U. S. Coast Survey.

APPENDIX No. 47.

Report of A. D. Bache, Superintendent of the United States Coast Survey, to the Secretary of the Treasury, correcting important errors in the position of the Farrallones and Point Lobos, entrance to San Francisco Bay.

Coast Survey Office,

Washington, April 24, 1851.

Sir: I have the honor to submit the following report from R. D. Cutts, esq., assistant United States coast survey, correcting important errors in previous reports as to the position of the Farrallones and Point Lobos, entrance to San Francisco bay, which I respectfully request authority to publish. These corrections are the results of a trigonometrical survey.

Very respectfully, yours,

A. D. BACHE,

Superintendent United States Coast Survey.

W. L. Hodge, Esq.,

Acting Secretary of the Treasury.

Schooner Baltimore,

San Francisco Bay, February 28, 1851.

Dear Sir: Under the head of the "Farrallones," in the sailing directions for the western coast, it is stated that—

"The southeast inlet is the largest of the group, and is distant from the fort, at the mouth of the harbor, twenty-eight miles, and bears from fort S. 68° W., true.

In the next edition of these directions the distance may be stated at 29.9 miles, and the true course from fort S. 75° 12′ W.

Adopting for the starting point the latitude and longitude of Fort Point, as given by Lieutenant McArthur in the published "tables," the latitude of the South Farrallone becomes 37° 41′ 37″, instead of 37° 36′ 30″; and the longitude of Point Lobos (the most western extremity) 122° 29′ 47″, instead of 122° 27′ 30″.

Very truly, yours,

R. D. CUTTS.

Prof. A. D. BACHE,
Superintendent U. S. Coast Survey.

APPENDIX No. 48.

Report of Lieutenant Washington A. Bartlett, United States navy, assistant in the coast survey, to the Superintendent, on the general character of the coast of California.

WASHINGTON, *January* 6, 1851.

SIR: In answer to your several inquiries of the 31st ultimo, I have the honor to state, that the general character and configuration of the coast of California exhibit bold precipitous cliffs, variable in height, occasionally interrupted by sand and shingle beaches. In some places the shore-line, even where faced by cliffs, is also a flat sand-beach, but in such cases narrow, and entirely washed by a full tide.

On all parts of the coast vessels may approach within a very short distance of the beach, without encountering any dangers not visible to the eye, except that of being hove upon the beach by the swell, if the failing of the wind should leave the vessel becalmed.

The hill-tops are generally rolling, but at times present long ranges of slightly inclined plains, or tables, partially covered with gigantic red-wood timber. Wild oats and rich grasses are abundant on all the hills and forest openings of the coast range.

The islands which lie off the coast between Cape Conception and San Diego are not yet determined in position, with any very close approach to accuracy. They are large and conspicuous objects to the navigation in clear weather, but require more thorough examination and determination. They are as follow: Santa Rosa, or Miguel, San Bernardo, Santa Cruz, Saint Nicholas, Santa Barbara, Santa Catalina, San Clemente, or Salvador, San Juan, and the Coronados isles.

Several of these islands have islets in their vicinity, and there are reefs and detached rocks reported in several places within their range.

Whether these reefs and islets are the *same*, being variously placed by navigators assigning them erroneous positions on the crude charts of that coast, which have been in general use by the coasters, or whether they are more numerous and dangerous than they appear on the general charts of the latest publications, is yet to be ascertained.

There is no part of the coast of the United States that requires an immediate and thorough examination with all the means at the command of the coast survey more than that part included between Monterey and San Diego.

Our late reconnaissance to the northward shows how indeterminate

have been previous authorities, and how very much superior it is to previously conceived notions.

To the southward and eastward of Point Conception the islands of San Bernardo, San Miguel, and Santa Cruz form the western border of the Santa Barbara channel or sound. This is the route of the coasting trade and Pacific mail steamships generally.

The light-house proposed to be erected on Cape Conception will be of great benefit to this trade.

In consequence of fogs and haze, the cape (which is bold, and clear of danger) must be made, in order to shape a course with certainty through the channel or sound of Santa Barbara.

The island of San Bernardo lies nearly due south of Cape Conception, distant 30 miles, "San Miguel" 33 miles SE., (compass,) and "Santa Cruz" 33 miles ESE., and eleven miles south of the anchorage of Santa Barbara.

The coast is clear of dangers, both on the main land and the eastern shores of the island. Navigators prefer to take the channel, in consequence of reported reefs and shoals, to the westward of San Miguel and north of San Nicholas. There is no doubt such do exist, and are as yet very uncertain in position.

The light-house for Cape Conception should be as near the shore as possible, having regard to height, for sea view. This light should be seen ten or eleven leagues, and be of the first class.

A position can be had for Conception light which will not require a tower higher than those on Navesink.

Beginning with the light at the Farrallone, off San Francisco, as a fixed light, I would recommend the following order to the southward:

Monterey a revolving light.
Cape Conception a fixed "
San Diego a revolving "

As the above will all be main sea-lights, they should be of the first class.

All other lights which the future wants of commerce may require in this district will only be secondary or local lights.

Respectfully submitted by your obedient servant,

WASHINGTON A. BARTLETT,
Lieutenant U. S. Navy, and Assistant Coast Survey.

Prof. A. D. Bache,
Superintendent U. S. Coast Survey.

APPENDIX No. 49.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating a letter from Lieut. W. A. Bartlett, U. S. N., assistant in coast survey, relating to the commerce of the Columbia River.

Coast Survey Office,
February 26, 1851.

Sir: I have the honor to send herewith a letter from Lieut. Wash'n A. Bartlett, United States navy, assistant in the coast survey, enclosing a

list of vessels which have crossed the bar of the Columbia river during the year 1850. I respectfully request that it may be communicated to the Committees on Finance and Commerce of the Senate, and Committee on Commerce of the House of Representatives.

Yours, very respectfully,

A. D. BACHE,
Superintendent Coast Survey.

Hon. Thos. Corwin,
Secretary of the Treasury.

National Hotel, Washington,
February 24, 1851.

Dear Sir: I herewith enclose a list of vessels which have crossed the bar of the Columbia river, Oregon Territory, during the year 1850. I received it this evening direct from the United States collector at Astoria.

By this list you will perceive that while the large number of 160 sail—of ships, barques, brigs, and steamers—have safely crossed the bar of the Columbia river during the year, no less than one hundred and forty-four sail have entered and departed by the new south channel, which was surveyed by the late Lieutenant Commanding W. P. McArthur, U. S. N., and myself, under your direction, the past season; the chart of which is now being engraved.

This list of vessels embraces a fleet of over eighty thousand tons burden, which in one year have entered and cleared at the custom-house at Astoria, without a solitary accident or loss of one dollar to owners or insurers by the passage of the bar.

It is very doubtful whether the commercial statistics of any other port of equal commerce can show such an exhibit.

Of the sixteen passages made through the old north channel, all but three were made by steam vessels, which fact has fully demonstrated two things: *first*, that the prediction long since made, that steam would certainly and safely open the navigation of the Columbia, and, *secondly*, that our reports of the past summer, that the *south channel* is the *practical commercial channel* of the river, are fully established to be correct by the showing of the pilots; they having taken *one hundred and forty sail* of sailing vessels through the *south channel*, while only *four* have passed through the *north channel.*

Since the publication of our sailing directions in June last, *ten sailing vessels have passed through the south channel without a pilot!*

The pilots have taken 17½ feet draught over the bar of the south channel.

In view of these facts, and my experience of the wants of the usual aids to commerce on this river, I have been addressed by a large number of the ship-masters and owners of vessels trading into the Columbia, to urge upon the proper departments of the government the necessity of hastening the work of building the light-houses, and placing the buoys, already provided by act of Congress.

Also, that the growing commerce of the port of Astoria demands an

immediate appropriation for a custom-house at that point, in order that the public business may be properly transacted. I have the honor, therefore, to request that copies of this communication be transmitted to the Secretary of the Treasury, and the Committee on Finance of the United States Senate.

In this connexion I may also mention that I was this day informed by Mr. Preston, surveyor general for Oregon, that in consequence of the publication of my report, made to you in June last, of the safety of the south channel of the Columbia, the insurance companies of St. Louis at once took risks for the river, at the same as for San Francisco. This is the direct influence of correct hydrographical information.

Sir, I have the honor to be, with high respect, your obedient servant,

WASH'N A. BARTLETT,

Lieut. Com'g U. S. N., and Assistant Coast Survey.

Prof. A. D. Bache,

Superintendent Coast Survey.

APPENDIX No. 50.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating information relating to Trinidad, Humboldt, and San Diego bays.

Ossipee Station, near Alfred, Maine,

September 29, 1851.

Dear Sir: The following information in regard to Humboldt harbor, Trinidad bay, and San Diego harbor and its approaches, has been received from Lieutenant Commanding James Alden, United States navy, Assistant R. D. Cutts, and Sub-Assistant A. M. Harrison. I would respectfully request authority for its publication.

Trinidad and *Humboldt bays* have been surveyed, and the charts will be ready to forward by the first proximo. The first-named is a very convenient and safe anchorage during six months in the year, and will be found by vessels that have suffered from the strong head (northerly) winds that prevail along the coast, a comfortable harbor of refuge.

Humboldt bay is, I think, the third harbor on this coast; it is sixteen miles long, and from three-quarters to four or five miles wide. The entrance between the breakers is nearly straight, but rather along the coast; it is about a mile long, and two hundred metres wide, between the eighteen-feet curves on either side, with twenty-one feet at low water on the bar. It is perfectly accessible, except in very heavy weather, when, I am informed, the sea breaks entirely across the entrance; but we had no trouble in getting in, and *beat out* against a very light air, with little or no tide in our favor. We have made a very careful examination of it.

San Diego bay.—From the perfect shelter it affords from all winds, and the depth of its water, San Diego bay is considered, next to San Francisco, the best on this coast. That such a large volume of water

should have such a small outlet is somewhat remarkable, as is also the very singular natural breakwater, Ballast point.

The Port La Playa is situated on the western shore of the bay, about one mile and three-quarters from the entrance. The anchorage is in between nine and ten fathoms. The custom-house is placed here, and it is also the place where the mail-steamers stop. An excellent road leads from La Playa to Old San Diego, which is a small town of a few adobe houses and unapproachable by water, even in boats.

New San Diego, now about a year old, is situated on a plain, at the base of the hills, on the east side of the bay. It consists of a few American-built houses, and a large storehouse for the quartermaster's department. The United States military depot is established there. A channel runs in a curve from La Playa to New San Diego, and vessels can carry from six to seven fathoms water. Both New San Diego and La Playa are dependent upon the river at Old San Diego for their water. Between the above-named channel and Old San Diego are large flats, mostly covered with grass, and partly bare at low tide.

The most important subject, however, connected with the bay, is the effect of the debouchement of the San Diego river—bringing with it, when high, (in the rainy season,) great quantities of sand directly into the channel.

It is believed, and apparently with reason, that unless the course of the river be changed, the channel will be ultimately filled, which will have the effect, I think, of not only cutting off communication with New Town, but also of destroying the bay entirely as a harbor; for it appears that nothing keeps the bay open but the great amount of water flowing in and out at the narrow entrance; and, when the channel is closed, the greater part of the bay is cut off, leaving an insufficient amount to keep the entrance clear. A bar would doubtless form across the mouth, and the bay will gradually fill up.

That the river does bring sand into the bay is asserted by the deputy collector of this place, and others who have the means of knowing; and, further, it is known that vessels at one time could anchor in False bay, but the river flowing into it destroyed it by filling it with sand; and it then turned its course into San Diego bay.

If such be the facts—and I see no reason to doubt them—the only remedy for the evil is to turn the river into False bay again. This is an excellent harbor, and its loss would be severely felt.

Respecting the tides, Mr. Gray gives the average as six feet, which is approximately correct. The pilots tell me that the tides vary in their rise and fall from nine feet (spring-tides) to three and a half during the year.

About two-thirds of the way from the Playa to the end of Ballast point is a shoal, having nine feet of water at low tide, but lately discovered.

Sailing directions for San Diego.—Vessels in sight of the coast, and approaching San Diego from the north, will observe an opening in the hills, and the appearance of an inland bay. This is the "False port," and must be avoided. Immediately north of "False port" commences a table land, about four hundred and fifty feet high, and extending southwardly six or seven miles. The extremity of this table-land is called Point Loma, and forms the entrance to the harbor of San Diego.

Those bound from the southward will first sight the group of high, rocky islets, called "*Los Coronados.*" From thence to Point Loma the course is N. ½ E., and the distance fifteen nautical miles. On a clear day "Los Coronados" will serve as a landmark and guide for vessels coming from any direction.

Steer right through the kelp, giving Point Loma a berth of one-half mile, and in a few minutes you will open Ballast point, a low beach of shingle stones forming a natural breakwater. Then round up gradually, until you bring Ballast point in range with the easternmost house on the Playa, *and be very careful not to open more of the village;* otherwise you will be too far to the east and in danger of getting aground on Zuningo shoal. The breakers show its position. During the summer keep as close to the hills, on your port side, as your draught of water will allow, as you will then be able to lay on the wind right up to Ballast point. You can carry four fathoms within a ship's length of the point. Keep on the above range, and, when up with Ballast point, steer direct for the Playa, and anchor as you please.

Inside of the breakwater, and about two hundred and fifty yards true north of its extremity, is a shoal spot, with twelve feet water at low tide. The shoals on the starboard hand are plain in sight, except at very high water.

Beyond the Playa, the shoals are easily distinguished. The channel, however, is buoyed. From the Playa to New Town—four miles distant—you can carry six fathoms of water. A mile or two beyond New Town the bay becomes shoal.

Very respectfully, yours, &c.,

A. D. BACHE, *Superintendent.*

Hon. THOS. CORWIN,
Secretary of the Treasury.

APPENDIX No. 51.

Sailing directions for entering the Columbia river as far as the harbor of Astoria, by Lieutenant Commanding W. P. McArthur, United States navy, assistant in the coast survey.

It is best, under all circumstances, to have a pilot; but should it be necessary to enter the river without one, the directions for the north channel are: First, bring Sand island in range with Point Ellice, and stand in towards Sand island, passing the south end of the north breaker. When Cape Disappointment and Leading-in cliff are in range, haul off towards the cape, keeping Leading-in cliff in range until nearly abreast the cape. Give the cape a small berth, and continue on towards Baker's bay until the second island in the bay can be seen; then keep off, and, with the second island and cape in range astern, it will pass clear of the north part of the middle sands. As soon as the soundings shoal on this course, keep off towards Sand island, and, passing close by the east end of the island, get the beacon on the island in range with a tree on Cape Disappointment, (which is trimmed up

like an umbrella,) and, with that range astern, stand on up the bay until the custom-house is on with Young's point, when haul to the east, and keep the last range on till nearly up with Young's point. Pass along the south shore, running by the lead, until up to Astoria.

To enter the south channel, bring the beacon on Sand island to bear north 40° east, (true,) and Point Adams on the peak, which can be seen east of Point Ellice, called "Jim Crow," (upon which there is a notable tree,) nearly in range; the vessel will be then on the bar in the south channel, in the best water. Steer for the beacon, taking care not to sag to the eastward; rather keep close to the breakers on the Sand island shore. Pass close to Sand island, and fall into the range of the beacon with the trimmed tree on Cape Disappointment, and proceed as already directed.

The best time for entering is on the first or last of the ebb-tide. The last of the ebb-tide is preferable in either channel.

APPENDIX No. 52.

Correspondence of Superintendent of the Coast Survey with the Secretary of the Treasury in relation to two sunken rocks in the harbor of San Francisco, reported by collector of that port.

1.

TREASURY DEPARTMENT,
July 21, 1851.

SIR: The enclosed letters from the collector of San Francisco, requesting that buoys be placed over two sunken rocks therein mentioned, are transmitted for your views on the subject.

You will please return the letters with your report, and if any report shall have been made to you by the officers of the coast survey in California, I will thank you to furnish a copy to the department.

Very respectfully, your obedient servant,

W. L. HODGE,
Acting Secretary of the Treasury.

Prof. A. D. BACHE,
Superintendent Coast Survey.

2.

COLLECTOR'S OFFICE, CUSTOM-HOUSE,
San Francisco, June 7, 1851.

SIR: I have the honor to enclose a copy of a letter I have addressed to the Hon. Stephen Pleasonton, Fifth Auditor, requesting authority to procure two buoys to place on two sunken rocks, very dangerous to vessels navigating the waters of this bay. It is of great importance

that these dangerous rocks should be indicated to navigators; and I trust the requisite steps may be taken as promptly as possible.

I have the honor to be, with great respect, your most obedient servant,

T. BUTLER KING, *Collector.*

Hon. Thomas Corwin,
Secretary of the Treasury, Washington City.

3.

Collector's Office, Custom-House,
San Francisco, June 7, 1850.

Sir: There are two sunken rocks in the straits between the bays of San Francisco and San Pablo, which are very dangerous to navigation, being directly in the track of vessels navigating these waters. Application has been made to me to have buoys placed upon them, and the officers engaged in the coast survey are ready to place buoys whenever they can be procured. Under these circumstances, please authorize some person to procure buoys to mark these dangerous hindrances to navigation.

Very respectfully, your obedient servant,

T. BUTLER KING, *Collector.*

Hon. Stephen Pleasonton,
Fifth Auditor, Treasury Department, Washington City.

4.

C. S. Station, Mt. Pleasant, Me.,
July 25, 1851.

Sir: I have the honor to acknowledge the receipt of your favor of the 21st instant, relating to buoys to be placed upon two sunken rocks in the bay of San Francisco, and requesting to be furnished with the information communicated to the superintendent by the officers of the survey.

In reply, I have the honor to state that Lieutenant Commanding Jas. Alden, U. S. N., assistant in the coast survey, and chief of hydrographic party on the western coast, under date of June 14, informs me that he has received numerous applications to place buoys on the Invincible and Blossom rocks, in the harbor of San Francisco, and that he considers it very necessary to the safety of navigation that buoys should be placed upon those dangers.

Fully concurring with Lieutenant Alden in his opinion, I would respectfully recommend that the necessary means may be furnished to the collector of the port of San Francisco, or to the superintendent of the coast survey, from any funds the department may have available for the purpose, to have the buoys procured and placed.

I return herewith the letters of Mr. King, the collector, as you request.

Yours, respectfully,

A. D. BACHE, *Superintendent.*

Hon. W. L. Hodge,
Acting Secretary of the Treasury.

APPENDIX No. 53.

Report of Lieutenant Commanding James Alden, U. S. navy, assistant in the coast survey, to the Superintendent, of the death of Passed Midshipman William De Koven, U. S. navy, assistant in the coast survey, on the thirty-first of May, 1851.

U. S. Surveying Schooner Ewing,
San Francisco, May 31, 1851.

Dear Sir: I have just time, before the steamer sails, to impart to you the melancholy news of the sudden death of Passed Midshipman William De Koven. His disease was apoplexy; and when I mailed my last letter to you, one short hour ago, he was not thought to be in any danger. I had known him but a few days, but in that time learned to honor and respect the noble qualities which adorned his character. This sudden and awful event has cast the deepest gloom over us all, and our thoughts turn with the saddest sympathy to those bereaved relatives and friends, whose hopes and affections are thus, in one short hour, made so desolate.

I enclose herewith Dr. Mitchell's report of the circumstances attending Mr. De Koven's death, and beg that, as there is not time before the steamer sails to do so myself, you will please to impart the sad intelligence to his friends, and to the Hon. Secretary of the Navy.

With great respect, I am sir, your obedient servant,

JAMES ALDEN,
Lieutenant Commanding, U. S. Navy.

Prof. A. D. Bache,
Superintendent U. S. Coast Survey, &c., Washington, D. C.

APPENDIX No. 54.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating the loss of the steamer Jefferson on the coast of Patagonia; with documents relative thereto.

1.

Ossipee Station, near Alfred, Me.,
September 1, 1851.

Sir: It is my unpleasant duty to report officially—what has already been communicated to you informally by the assistant in charge of the

coast survey office—the wreck of the steamer Jefferson, and her abandonment after survey, at Port Desire, Eastern Patagonia.

The whole of the circumstances are described in the letter of Lieutenant Commanding F. K. Murray, United States navy, a copy of which is herewith transmitted, together with a copy of the report of the officers who made the examination of the vessel at Port Desire; and recommended her abandonment as beyond the means accessible for repairs.

Such was the violence of the storm to which the vessel was exposed, that there appears more cause for thankfulness that the lives of the officers and crew were preserved than of regret that the vessel was disabled. The commander, and his officers and crew, appear to have done all that was practicable under the circumstances.

I transmit herewith a copy of the letter of Lieutenants Alden and Jenkins, recommending the sending of the Jefferson to the western coast; and of that of Lieutenant Commanding Murray, in reply to inquiries addressed by me to him before leaving port. The department will see from them that the best professional advice was had before sending the vessel to the western coast, and that she was fully equipped for the voyage.

I have not yet received advices of the arrival of the officers and men of the Jefferson in the United States. It will be seen that their return may soon be expected, and that such portions of the machinery of the steamer as it may be possible to ship will be brought with them.

Very respectfully, yours,

A. D. BACHE, *Superintendent, &c.*

Hon. Thos. Corwin,
Secretary of the Treasury.

2.

Letter of Lieutenant Commanding F. K. Murray, United States navy, to Superintendent of Coast Survey, reporting the loss of the Coast Surveying Steamer Jefferson.

U. S. S. Steamer Jefferson,
Port Desire, East Patagonia, June 3, 1851.

Sir: It becomes my unpleasant duty to inform you of the disasters which have befallen the Jefferson since leaving Montevideo, and driven us into this port, a complete wreck. After our sailing, the weather continued good until the 23d ultimo, when its threatening appearance, and the low state of the barometer, gave warning of a heavy gale. It overtook us upon the 24th, from the northward, and as it increased, all necessary and usual precautions were taken to make the vessel secure; the top-gallant yards and mizzen-topmast were sent upon deck; the hatches battened down; relieving tackles hooked, &c.; and until the morning of the 25th, the steamer scudded safely before the wind, which hauled on that day to WNW., and blew with terrific violence, raising a mountainous, irregular, and cross sea, which con-

stantly threatened our destruction. To keep ahead of this, all sail that could be carried in addition to full steam was necessary; and at 3 o'clock, p. m., she had on the close-reefed foresail; close-reefed maintop-sail, and reefed fore storm-staysail. At about that time, a heavy cross sea from the northward broke over the port-gangway, and threw the vessel upon her beam-ends, when she instantly broached to and lay exposed to the heavy sea following us. I was on deck, as I had been, without interruption, during the gale, and immediately gave the order to let everything fly but the staysail sheet; and quickly afterwards, finding she did not recover, that the sea continued to break over her, and the vessel to settle, to cut away her masts. To the promptness and coolness with which this order was obeyed, we are indebted for our lives. Relieved of the masts, she righted and fell off before the wind; but, for some moments before their fall, there appeared no earthly hope that the vessel could remain above water a minute, so fast and far had she settled into the sea. Fortunately, both masts fell clear of the wheel-houses, but for some time we lay exposed to the fury of the waves, until their rigging could be disentangled from the lee-wheel. This accomplished, I directed the vessel to be hove to under low steam and the reefed spanker, the only sail left; for, fortunately, the mizzen-mast was retained when the fore and main fell.

At about six o'clock, while laying to, another heavy sea broke on board, on the port-bow, and swept fore and aft, staving in the bulkheads of the engine-room, wheel-houses, &c., and carrying the steering-wheel overboard. This shock strained the steamer's hull terribly from bow to stern, and she afterwards worked and labored so much that I was apprehensive she would break in two. As soon as the hatches could be opened, I ordered water, provisions, stores, everything that could possibly be spared, to be thrown overboard, which was done with excellent effect; but, though relieved, the working of the vessel's frame continued to such a degree that it appeared doubtful whether she could hold together to reach port. To add to our misfortunes, the vessel had begun to leak badly; the bilge-pumps, choked by the coal, would not work, (no uncommon occurrence with them;) and the frames of the engines had started from the hull, and, though instantly secured by chain, were momentarily expected to break down, and under full steam could make but six revolutions. It appeared that nothing but a miraculous interposition of Providence could save us, and we have great cause for gratitude that this was accorded us; for in a few minutes after the shock which disabled the vessel, the wind hauled to the southward and westward, and began to die away, and the sea to subside. A continuance of the gale, or another of even ordinary strength, before we reached here, would have caused our destruction. We continued to lay to until noon of the 26th, when we found ourselves, by obervation, distant 110 miles from Sea Bear bay, bearing SW. by S. The sea having gone down, and a jury-mainmast been rigged, I steered for that port, but, owing to the state of the engines and hull, our progress was slow, and we did not arrive until the 28th, in the afternoon. Yesterday I brought the vessel to this port, (which is in sight from Sea Bear bay,) finding it to be better protected from the gales which prevail at this season.

I omitted to mention that, at the time of her accident, the Jefferson had but seventy tons of coal on board, the deck-load taken on board at Montevideo having been consumed.

After my arrival in port, the disabled state of the vessel became with me a matter of painful consideration. I had hoped that she might be repaired so as to continue her voyage; but on a close examination the painful conviction forced itself upon me that to attempt it would be to incur an unavailing and fruitless expense. The vessel is evidently shattered fore and aft, continues to leak badly at her anchors, droops forward and aft, and presents every appearance of having broken amidships.

In my opinion, and in that of the officers, as contained in their report, an iron vessel cannot be extensively repaired out of dock; certainly not by heaving down, in any port of this rock-bound coast—exposed to boisterous weather, heavy seas, and a rise and fall of tide of over twenty feet. I have directed a survey upon the hull of the steamer by the engineer and other officers attached to her, and herewith enclose their report, in which I feel it a duty to those whose lives are intrusted to my charge to coincide. As they considered that the necessary repairs cannot be made out of dock, and the vessel utterly unseaworthy in her present state, as whether we return or go forward, proceed north or south, there lies before us a dangerous and tempestuous coast, I see no alternative but to adopt the unanimous advice of the officers under my command, and abandon the wreck. I have therefore directed the machinery, boilers, &c., to be removed, and, with whatever other government property can be shipped to advantage, intend to place them on board a vessel now loading here for the United States, and expected to sail in a month or six weeks, should no earlier opportunity offer. I shall also return in her with the officers and men.

Within twelve miles of this port, on Penguin island, is a settlement of guano gatherers. The gentlemanly proprietor of the island, Mr. Powell, has kindly offered us every assistance in his power, and will provide provisions for the crew during our stay.

In conclusion, sir, I need hardly say that I abandon this vessel with feelings of deep regret, but with a consciousness that my duty requires it; and that during the perils through which we have passed, no effort was wanting on the part of myself and officers to secure her safety and that of her crew. I take pleasure in bringing to your notice the excellent conduct of all under my command during the trying scenes of the late gale. To their firmness, coolness, and prompt obedience of orders, at a time when death appeared inevitable, we owe our lives, and the government what has been saved from the wreck. For seventy-two hours all hands were constantly on deck at the pumps and bailing, without rest, drenched by the sea, and benumbed by cold; yet all did their duty with a courage and manliness to which I am proud to bear testimony. I would particularly mention the conduct of Mr. Garvin, the engineer in charge. His gallantry in perilling his life in the wheel, held only by the engine, and on which the sea was constantly breaking, to clear it of the rigging of the wreck of the foremast. I am happy to say that no lives were lost, though several men were severely injured during the gale; but I regret to inform you of the death of Lewis M.

Dumore, (landsman,) of Wilmington, Delaware, which occurred suddenly on the 21st ultimo.

I am, very respectfully, yours, &c.,

F. K. MURRAY,
Lieutenant Commanding.

Prof. A. D. BACHE,
Superintendent Coast Survey, Washington D. C.

3.

Letter of Lieutenant Commanding Murray, U. S. N., to the officers of the Jefferson, ordering a report of the injuries sustained and the course to be pursued in relation to her; and their reply.

U. S. STEAMER JEFFERSON,
Port Desire, June 3, 1851.

GENTLEMEN: You will hold a survey upon this vessel, and report to me what injuries have been sustained in her hull and engines during the recent gale of the twenty-fifth ultimo; whether she is now in a situa- to go to sea, or can be repaired so as to enable her to do so. If in your opinion she is unseaworthy, and cannot be repaired here, you will please state what course it would be most advantageous to pursue with regard to her.

I am, respectfully, &c.,

F. K. MURRAY,
Lieutenant Commanding.

Acting Master C. W. PLACE,
Passed Midshipman W. H. WILCOX,
Passed Midshipman G. CILLEY,
Passed Midshipman D. P. MCCORKLE,
First Assistant Engineer B. F. GARVIN,
Second Assistant Engineer R. H. LONG,
Second Assistant Engineer W. NONES,
Third Assistant Engineer W. H. RUTHERFORD.

U. S. STEAMER JEFFERSON,
Port Desire, June 3, 1851.

SIR: In compliance with your order of June 3, we have held a survey upon this vessel, and report the injuries sustained in her hull and engines during the recent gale of the twenty-fifth ultimo, as follows, viz: She droops on starboard bow and port-quarter, has the appearance of being logged, which opinion is strengthened by her working and laboring very much in a sea-way. She makes twenty-three or twenty-four inches of water per day, from which we conclude that some rivets on the bottom have started. Fore and mainmast gone, and jib-boom gone, with their sails and rigging. Decks droop and leak fore and aft; all the joiner's work on the forward and after-guards gone. Wheel-houses

and port hammock-netting partially carried away; also steering-wheel and engine-room bulk-head stove in; a bad leak on the starboard bow; first cutter's planking stove off; upper half-ports and binnacle gone; the ship steering wildly, rudder is supposed to be injured; deck pump flanch broken; outer frames of the engines work three inches, and engines work fore and aft.

We do not consider her in a situation to go to sea; neither can she be repaired so as to enable her to do so without being docked; and in our opinion she is unseaworthy, and cannot be repaired here; and, in duty bound, we unhesitatingly advise that all valuable property on board should be taken from her, and, with the ship's company, embarked on board some staunch vessel to return to the United States, abandoning her much-wrecked hull and leaving an agent in charge for further instructions.

We are respectfully, &c.,

C. W. PLACE,
Acting Master.
WM. H. WILCOX,
Passed Midshipman.
GREENLEAF CILLEY,
Passed Midshipman.
D. P. McCORKLE,
Passed Midshipman.
BENJ. F. GARVIN,
First Assistant Engineer.
ROBERT H. LONG,
Second Assistant Engineer.
W. H. NONES,
Second Assistant Engineer.
WM. H. RUTHERFORD,
Third Assistant Engineer.

Lieutenant Commanding F. K. Murray,
Commanding United States Steamer Jefferson.

4

Report of Lieutenants Commanding James Alden and Thornton A. Jenkins, in regard to fitness of steamer Jefferson for hydrographic party on western coast.

United States Coast Survey Steamer Jefferson,
Baltimore, October 17, 1850.

Sir: We have respectfully to report, in compliance with your instructions of the 15th instant, on the points contained therein, viz:

1. That the steamer Walker is not adapted to hydrographic service on the western coast as an efficient steam vessel.

2. That the Jefferson may be rendered fit for that service, and may be sent safely under sails to her destination.

3. To prepare the Jefferson to proceed with expedition to the Pacific,

it will be necessary to have the wheel-houses and wheels taken down, and the parts so fitted as to enable the engineer's crew on board to replace them in the space of three to four weeks' time.

4. It will be necessary to convert the Jefferson into a barque; her fore and mainmasts occupying the same position as at present, and a small mizzen-mast, placed just forward of the cabin bulk-head, to carry a spanker. The fore and mainmasts and spars to be of the proper dimensions of a sailing vessel of her tonnage.

5. To make the Jefferson an efficient steamer surveying vessel, there will be required new boilers, new bilge and force-pumps, and the necessary connexions to be made to the new boilers.

6. It will require from six to seven weeks to construct the boilers, and from three to four weeks to put them in their places and fit the proper connexions.

7. The Jefferson can be masted and rigged in a month from the time the order may be given, if attended to by a competent and zealous officer.

8. It is believed the engines can be thoroughly overhauled and put in complete order for any service connected with hydrography, embracing the recommendations of the engineers appended, for the sum of $1,500 00

Probable cost of boilers 8,000 00

Amount 9,500 00

9. The whole amount for preparing the Jefferson for the voyage around Cape Horn may be assumed at about... 4,000 00

Making the total expense 13,500 00

10. We would call your attention to the estimates, &c., appended, upon which we have been compelled to rely in a great measure.

11. The crew can dismantle the vessel after reaching her destination in about three days.

12. To get her ready for steaming it will require about four week's work by her engineers and firemen.

13. The carpenters of the vessel could replace the wheel-houses in a few days, the materials being prepared here for doing so.

Very respectfully submitted.

THORNTON A. JENKINS,
Lieutenant Commanding and Assistant Coast Survey.
JAMES ALDEN,
Lieutenant Commanding and Assistant Coast Survey.

Prof. A. D. Bache,
Superintendent U. S. Coast Survey, Washington, D. C.

5.

Reports of Lieutenant Commanding Murray, United States navy, to the Superintendent of the Coast Survey, in relation to the fitness of the Jefferson for voyage to, and duty on, western coast.

WASHINGTON, D. C., *February* 20, 1851.

SIR: In reply to your inquiries in relation to the surveying steamer Jefferson, * * * * * * * * * I respectfully state that, the trial of her boilers and machinery having been made at anchor, I can answer generally that they worked during the greater part of a day to the entire satisfaction of myself and engineers, and that the latter officers were of opinion that no further trial would be necessary before proceeding to sea.

In casks and tanks, the Jefferson carries about 3,500 gallons of fresh water, sufficient, at the ordinary rate of consumption, for about thirty days. The condenser recently fitted to one of the wheel-houses will yield a supply equal to the daily consumption, and will enable us to keep the casks and tanks filled, adding thereby to the vessel's stability under sail.

Eighty tons of coal can be stored in the bunkers; when these are filled, I hope to be able to take twenty more on deck in bags. I cannot say, until all the stores are on board, whether or not it will be prudent to do so.

Her outfit in every particular is good; so also are her spars, sails, and rigging. Three months' provisions for her crew have been put on board, which will last four months, adding thereto the undrawn rations.

Never having been at sea in the Jefferson, I cannot answer positively in regard to the fifth query, but may say that I see no reason to doubt that she will be perfectly safe at sea, and believe that her machinery has never been in so good condition for service as now. Most of her firemen are good mechanics, and will be able, with the means at their disposal, to make any repairs (in case of mishap) which can be effected at sea.

* * * * * * * * *

I am, sir, very respectfully, your obedient servant,

F. K. MURRAY,
Lieutenant Commanding Steamer Jefferson.

Prof. A. D. BACHE,
Superintendent U. S. Coast Survey, Washington.

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PHILADELPHIA, *February* 28, 1851.

SIR: At the request of Mr. Alden, who wished to witness the performance of the Jefferson under way, I made a trip in her to Newcastle on the 25th instant. He has, I presume, informed you of its result, which was perfectly satisfactory, except in one particular—the large consumption of fuel; it having been consumed at the rate of ten tons per day. I enclose a report of the engineer in charge, recommending an

alteration which will tend to economise it; and as time was not allowed to communicate with you, I have authorized the work, which will be completed to-morrow.

With twenty-six pounds of steam, making twenty-one and a half revolutions per minute, the Jefferson came up from Newcastle at the rate of ten knots per hour, against wind and tide, and showed more stability under sail than I had expected. The wind being fresh and flawy from northwest, gave an excellent opportunity to test her capacity to carry canvass.

* * * * * * * * *

I am, sir, very respectfully, your obedient servant,

FRANS. KEY MURRAY,

Lieutenant Commanding Steamer Jefferson.

Prof. A. D. Bache,

Superintendent Coast Survey, Washington.

APPENDIX No. 55.

Report to the assistant in charge of the Coast Survey Office on the electrotyping operations of the Coast Survey, by George Mathiot, electrotypist.

Electrotype Laboratory, Coast Survey Office,
Washington, November 29, 1851.

Dear Sir: In compliance with your request, I present the following report of the electrotype art as now practised in this office. Most of the apparatus and processes here used are entirely new.

To clearly exhibit the advantages derived from their introduction, it will be necessary to consider the scientific principles involved in their use, and also to take a cursory view of the history of the electrotyping art.

The art of working metals by electric currents is of very recent introduction; and, although it has advanced with great rapidity, it is yet, perhaps, but in a state of infancy in its applications, and of crudeness in the modes of conducting it.

The electro-deposition of metals was observed by most experimenters with the voltaic battery. As early as 1804 electro-gilding had been successfully practised; but the idea of making castings by electric currents does not seem to have occurred to any one previous to the introduction of Daniel's battery, to which electro-casting is incidental.

After the introduction of Daniel's battery, it simultaneously occured to several persons that electric currents might be used to make castings of a finer kind than were obtained by melting and pouring. Propositions to this effect are about all that can be attributed to the rival claimants for the invention of electro-metallurgy; for neither the English nor Russian philosopher revealed what had not been known before.

Yet to Jacobi and Spencer is due the merit of having called public attention to the subject; for in doing that, they have conferred benefits on the world greater, perhaps, than by making an original discovery.

After the publications of Jacobi and of Spencer had called the atten-

tion of the scientific world to the new art, the principles involved in it became the study of several eminent philosophers, who disclosed the methods to be followed for obtaining reguline metal. After this, several departments of electro-metallurgy rapidly advanced. Electro-plating, and the multiplication of pages of letter-press work, as pages of type, and wood cuts, (electro-stereotyping,) were soon extensively practised; but the copying of the delicate touches of the copper-plate engraver (the electrotype proper) was beset with difficulties. On account of the great value of the engraved plate, together with the risk of its being destroyed in the attempt to copy it, and the uncertainty as to whether the duplicate would have good metallic properties, even if the operator should have the good fortune to obtain one, this department of the art, (the first and most beautiful of Spencer's suggestions) was allowed to rest as an experiment or be confined to articles of small size and value.

Adhesion of deposite to matrix.

Electro-metallurgy requires that the deposited metal should have all its cohesive properties. If such a deposite of copper is made on a clean plate of copper, it is obvious that the deposited metal will cohere with the plate on which it is made, and an elaborately engraved plate would thus be converted into a mere mass of metal. The electrotype art, therefore, cannot exist before means are provided for preventing this destructive adhesion.

Various plans for overcoming this difficulty have been proposed. All these, however, have a common feature, which is to prevent the deposite and matrix from touching by means of an intervening film of heterogeneous matter.

Mr. Smee proposes to use that coating of air which adheres so firmly to polished metals, (so strikingly exhibited when the attempt is made to wet a polished knife-blade.) To obtain the air coating, he directs that, after every attachment has been made to the plate, it be placed in a cool and moist cellar for a few days before introducing it into the electrotype vat.

Smoke, black lead, oils, and powders, and wax, have also been proposed for covering the face of the plate.

The method used in the British ordnance survey is perhaps the best of all these. This is conducted as follows: The plate is first well oiled, and the oil well wiped away with soft bread. The plate is then heated to above the temperature of melting wax, and a cake of white wax pressed against the edge. The oil having removed the air from the plate, the wax will flash over it in an extremely thin sheet or film. All excess of wax is then to be wiped away with a fine linen cloth, free from lint. The plate must be left to cool before introducing it into the vat.

To smear the face of the finely engraved plate is in opposition to the fundamental idea of the electrotype, which is that of atomic casting. In the process of Mr. Smee, air bubbles will be retained in the fine lines of the graving, thus mutilating the copy; moreover, the face of the new

plate is waved from the agitation of the stratum of air when receiving the first portion of copper.

In the waxing process it is almost impossible to free every line from excess of wax. Even days of tedious application do not insure perfection. In addition to the coarseness of these various methods, they are extremely uncertain as to whether they effect the purpose for which they are applied.

It was always observed that if the deposited metal was *not deficient* in mechanical properties, it stuck very hard to the original, and the plates had to be subjected to violent jarring, heating, and beating, to separate them. But if the deposited metal was of very fine quality, then most likely the deposite was inseparably united to it. From these circumstances attending the adhesion of the deposite, it occurred to me that, when the cohesive force was but feebly developed in the deposited metal, then the force of cohesion or homogeneous attraction could not extend the distance presented by the thickness of the film of heterogeneous matter between the plates; but that when these forces were well developed, the spheres of homogeneous attraction of each plate would extend through the wax or air film.

It may be proper here to remark that the above views of adhesion have been applied to another department of electro-metallurgy with the most gratifying success.

In electro-plating the difficulty of obtaining a firm adhesion of the film of precious metal is entirely obviated by making such arrangements as insure a rapid deposition of highly ductile metal at the moment the article to be plated is immersed in the electrotype.

In considering the sticking of the plates, after homogeneous attraction or cohesion, heterogeneous attraction or adhesion demands attention; for two similar bodies may be separated by a film of heterogeneous matter, which binds them more firmly together than their particles are held together by cohesion, as we see in the use of cements.

This force is very powerful between some bodies, while between others it is very slight. Air adheres very strongly to metals, as before referred to; hence a film of air may unite two copper plates, even though they are separated beyond the distance at which cohesive attraction takes place.

Wax is a common ingredient in cements; its adhesive properties have become proverbial; its use is evidently improper. Therefore a substance having a strong adhesive attraction for the plates must not be on the face, and the cohesive force of the surface particles must be suspended by other methods than making the deposited metal deficient in mechanical properties.

It was hoped that a substance could be found that would act uniformly and gently on the surface of the engraved plate, and, in destroying the homogeneous attraction of the surface particles, would, by chemical union with them, form an insoluble and friable compound, having but a slight adhesion to the plate. I was led to select iodine for the experiment on account of its sparing solubility in water, its high equivalent number, and innoxious qualities. A copper plate was well cleaned, exposed to the vapor of iodine, and electrotyped; the deposite separated

from it readily. This was repeated some hundred times with invariable success.

It was found, in cleaning large plates for the application of the iodine vapor, that while one part of the plate was being cleaned, another part would tarnish, and hence a uniform action of the iodine could not be obtained. This led to silvering the plates before iodizing, which facilitated the cleaning and exhibited the action of the naligen. A silvered plate was washed with an alcoholic solution of iodine and electrotyped; the electrotype separated from the matrix yet more readily than before, the iodide of silver serving better to prevent adhesion than the iodide of copper.

But it was soon observed that a plate prepared on a dull day did not separate so readily as one prepared under a bright sky, and on experimenting it was found that a plate iodized and exposed to sunshine would separate with very great facility; while a plate iodized on a rainy day, and placed in a dark room for a few hours before introducing it into the vat, might stick so hard as to require some of the old resorts of heating and jarring to separate it from the matrix.

The process of iodizing and exposing to light has now been applied to a very great extent of finely engraved surface, and in no case has the least difficulty been found in lifting one plate off the other when the requisite thickness had been obtained.

I am aware that it may be thought that the iodine acts only by intervening between the plates; but the quantity of iodine applied to a plate must be thought insufficient to effect it by mere mechanical separation when we consider the large quantity of silex and carbon found in ordinary copper. If but one ounce of copper be dissolved from a square foot of ordinary plate, a very heavy deposite of impurities is left, (sometimes 5 per cent.,) and the quantity of wax which may be applied to a plate, and fail to prevent sticking, is ten thousand times more than the quantity of iodine which prevents it.

In preparing our largest plates, having ten square feet of face, I use a solution of one grain of iodine in twenty thousand grains of strong alcohol. If one grain of the solution is required to wet a square foot, it will give but $\frac{1}{20000}$ of a grain of iodine on a square foot. But as the iodine evaporates rapidly with the alcohol, probably the actual quantity on a square foot does not exceed one-hundred-thousandth part of a grain.

Taking the weight of a cubic inch of iodine at 1,250 grains, and supposing that it remains on the silver surface in its elementary state, instead of forming iodide of silver, then we have $1{,}250 \times 144 \times 100{,}000 = 18{,}000{,}000{,}000$, only one-eighteen-thousand-millionth part of an inch for the thickness of the coating of iodine. Even if we suppose that the solar rays decompose the iodide of silver, and leave the iodine in vapor on the plate, it will still be only one-forty-four-millionth part of an inch—a thickness to be taken as nothing in a mechanical view.

To test the effect of the chemical method of preventing adhesion on the sharpness of the engraved lines, an engraving was seven times successively transferred from plate to plate, when the closest inspection failed to show any inferiority of impressions from the last plate as compared with those from the first.

Time and expense of electro-casting.

Next in importance to securing a certain and easy separation of the matrix and casting is bringing the entire time and expense of electrotyping within the narrowest limits.

Mr. Smee and others have shown that the quality of electro-metal is determined by certain relations between the rapidity of forming the plate and the strength of the solution in which it is formed. Both the common operations of the electro-metallurgist, and the improvements he proposes, must conform to these relations.

As small quantities of electricity are easily set in motion, small-sized electro-castings are readily made in six or eight days. To make large castings in a short time requires a powerful current. To accomplish the corresponding augmentation in the effective electric action has proved a somewhat difficult matter.

At the date of the "Aide Mémoire to the Military Sciences," it is stated that in the ordnance survey one pound of copper was deposited in twenty-four hours on a plate of eight square feet, the plates being made ductile enough to bear hammering only by continued agitation of the electrolytic solutions.

At this rate, to make a plate one-eighth of an inch thick will require forty-five days. So far as I am informed, the above performance has not been excelled, as to quality and time, on large work anywhere prior to being attained as now to be described.

The first and most obvious suggestion for increasing the rate of deposition is to enlarge the battery; this, however, is incapable of producing the desired end.

To present this subject in a clear and satisfactory manner, I will make use of the celebrated formula of Professor Ohm, who deduced from mathematical reasoning, and established by experiment, that the effective force of the current from any battery was directly as the electromotive force, and inversely as the resistance offered to that current.

To express this, he gave the equation $\frac{E}{R+r}=Q$, in which E represents the electromotive force, or affinity of acid for zinc, and $R+r$ the resistance to the current generated by that force; R representing the resistance offered to it from the liquid contained between the positive and negative elements of the battery, and r the resistance offered by the object on which the battery is working, and Q the amount of work executed, or the quantity of the current obtained.

The resistance of conductors has been found to be directly as the length, and inversely as the section.

So far as concerns form of arrangement, E is constant, for the materials used, as it depends on their chemical relations, Q can therefore be favorably affected only by varying R or r. Now, as R represents the resistance of the liquid contained between the battery plates, to increase the size of the plates is only to increase the section of the liquid, or, in other words, to diminish the resistance represented by R. The expression, $\frac{E}{R+r}=Q$, shows that, if the resistance in the battery is small

compared to the external resistance, the gain of effect from enlarging the battery plates is but small.

To determine the relative value of R, as compared with r, a battery was constructed so as to collect and measure the gas evolved by its action.

The plates were placed in contact with each other, and the gas evolved in thirty minutes taken as a unit of effect. As in this case the current did not pass through anything but the battery, there is no resistance to be represented by r, or r in the formula will be equal to 0 and $Q=\frac{E}{R}=1$.

The battery was then attached to a pair of electrodes, in a certain solution of sulphate of copper and sulphuric acid, especially recommended by all the writers on electro-metallurgy, the arrangement being such as to produce good metal. The gas now evolved in thirty minutes was found only one-twentieth of the former amount; hence the introduction of the resistance, r, had diminished Q twenty times, and $\frac{E}{R+r}=Q=\frac{1}{20}\ \frac{E}{R}$, whence r is equal to 19 R. To exhibit the effect of battery enlargement, we now have $Q=\frac{1}{\frac{1}{m}+19}$. If $m=1$, then $Q=.05$; if $m=2$, $Q=.0512$; if $m=3$, $Q=.0518$; if $m=4$, $Q=.0524$, &c., &c. This shows a gain of only a fortieth from doubling the size of the battery, &c.—an advantage too small to repay for the enlargement. These calculations are in accordance with experimental results from small batteries, but in large ones the necessity of further separating the plates, in increasing their size, makes the resistance increase, instead of diminish, and there is consequently a loss from enlargement. It is not, therefore, by merely increasing the battery surface that the time for electrotyping can be shortened.

Mr. Smee, the distinguished writer on electro-metallurgy, by covering the negative plate of the battery with pulverulent platinum, produced a very energetic form of the instrument. When the plate is freshly platinized, it acts violently, and throws off the hydrogen in torrents. But this increased energy of the plate is gradually lost, from the electrive current depositing upon it impurities from the zinc.

As this deposite has a strong attraction for the hydrogen, it is retained on the plate. The plate, being thus encased in air, is virtually excluded from the liquid of the battery. The ordinary solvents of the metals do not readily remove this coating of impurity. The plate can be renewed by replatinization; but, as this is both tedious and expensive, I was urged to find a menstruum which would restore the original platinum to its energy. This I attained, at length, by immersing the plate in a solution of per-chloride of iron, which almost immediately restores the action of the plate.

The plates are now daily immersed in the chloride of iron, by which the tone of the battery is constantly maintained.

By this last discovery, together with obtaining better solutions for the decomposing cell, the time for making a casting was reduced; but still

the time required for making a plate was too long when only one electrical equivalent was employed.

The effective force of one battery may be added to another. This is increasing E in the formula, and this will sometimes increase Q.

We unite the effective force of many batteries by joining their dissimilar ends in consecutive order. As the current in such an arrangement has to traverse every battery in the chain, R will be multiplied as many times as we multiply E. The formula then becomes $Q = \frac{n\,E}{n\,R+r}$. When the value of r and R are nearly equal, and we have batteries of definite construction to work with, it becomes a matter of some importance to determine whether we shall use the whole galvanic apparatus, as a single electrical equivalent, by connecting all the similar parts of all the battery cells, or whether we shall convert it into a battery of two pairs, in consecutive order, by joining dissimilar ends. As doubling the battery is doubling R, and to double the electrical equivalents is also to double R, we shall increase R fourfold by the double arrangement. Instead of $Q = \frac{E}{R+r}$ we have $Q = \frac{2\,E}{4\,R+r}$. Taking $R = r$ we have $Q = .50$ in the single arrangement, and $Q = .40$ in the double—showing that we may double the expense, and yet make the casting more slowly than before. Conditions as above are of frequent occurrence, and a knowledge of them without experimenting is of very great importance.

For $R = 10\,r$, with a single equivalent of battery, $Q = \frac{1}{1+10} = 0.0909$.

For two batteries in series $Q = \frac{2}{2+10} = 0.166$. The use of two batteries in consecutive order, as thus exhibited, doubles the expense, but does not double the effect. A regard for economy prohibits us from further increasing the series. To represent an effect double of $\frac{E}{R+r}$ we have

$$2\left(\frac{E}{R+r}\right) = \frac{2\,E}{\frac{2\,R+r}{2}}.$$

As dividing R by 2 is doubling the battery surface, we may now make $Q = .183$. The gain per cent., now indicated by doubling the surface, makes it advantageous to make this increase when two consecutive batteries are used.

The difficulty of obtaining large flat plates of silver proved a serious obstacle in effecting an increase of battery surface, for the irregularity of the surface requires the plate to be placed at an increased distance from the zinc, thereby augmenting R, the very thing sought to be diminished.

Plates could be made flat by the planishing hammer; but the operation being expensive, and the plates continually liable to accidents in use, economy prohibited this mode of forming flat plates. Though the plating of metallic bodies with silver had been well executed, it had not yet been determined that electro-casting of silver could be executed

in a desirable manner, and at a moderate expense and trouble. At first, every attempt to make plates weighing 2,500 grains to the square foot failed, on account of the impossibility of observing Mr. Smee's laws relative to E for the time required.

But after modifying the solutions of silver, and using a register battery, a plate could be made in thirty hours, perfectly flat, and possessing the mechanical qualities of hardness, elasticity, and malleability, in an eminent degree, and not costing over 16 cents per ounce for the making.

The perfectly flat plates admit of a very close approximation to the zincs. Their size may therefore be increased to more than twice their former surface. As in the double arrangement, r is relatively smaller to R.

Important changes have also been made in the modes of operating, and in the arrangement of the apparatus. It had early been noticed that changes of temperature influenced the rate of working; and every electro-metallurgist knows the importance of keeping the laboratory warm.

To determine where and how the effect of temperature took place, a battery, at 60 degrees of Fahrenheit, was connected with a wire 120 feet long, and enclosing a galvanometer. The deflection was 40 degrees; the battery was then cooled until the temperature was 48°; the needle was still deflected nearly 40 degrees.

This experiment indicated that the batteries were not greatly affected by ordinary variations of temperature. Advantage was then taken of this development to secure a more perfect ventilation. Accordingly, a small room, to contain the battery, was partitioned off from the general apartment by a glass partition, and large outward openings made at the top and at the bottom of the room, to give a circulation of air for carrying off the battery fumes.

At the stage of improvement now described, one of our medium plates, having 8 square feet of surface, could be readily made in from 8 to 10 days. But wishing to still further quicken the process, or attain my first desire—to deposite one pound per day on the square foot, with a single equivalent of battery—improvements were again sought after. As the E of the formula has been increased to the greatest extent the cost would permit, and r had been diminished, or the plates increased in size to the greatest useful extent, it was sought to increase Q by diminishing r, or the electrolytic resistance. It was sought to increase the conducting power of the electrolyte by adding easily decomposable salts to it; but with no success. The accelerating effect of temperature being found, as above stated, to be confined chiefly to the decomposition cell, it was evident that by using the electrolyte alone, at a high temperature, a considerable advantage might ensue.

To determine the most advantageous working temperature, and the resulting gain of effect, a voltameter battery was connected to a pair of electrodes, in the solution formerly described as being generally recommended. Each electrode had five square inches of face, and was coated on the back to prevent radiation. They were placed one inch apart, and had thin plates of wood bound against their edges, to prevent any lateral spread of the current in passing between them. The following was then obtained:

Battery plate in contact	gave 300 cubic inches gas per hour.						
Electrodes in contact	do. 216		do.	do.	do.		
Current through electrolyte,	at 58°, gave	16	cubic in.	gas per h.		23.15
Do.	do.	60° do.	20	do.	do.	18.15
Do.	do.	100° do.	27	do.	do.	13
Do.	do.	175° do.	37	do.	do.	8.96

The last column of figures shows the value of the resistance of the solution, as compared with R of the formula. This column was obtained by first uniting the battery plates, and afterwards the electrodes.

From the above table it appears that heat may be made to diminish the resistance in the decomposition cell in the proportion of 2.58 to 1; and the whole resistance by 2.25. And as $\frac{2\,E}{R+r} = \frac{E}{\frac{R+r}{2}}$; therefore, by heating the electrolyte, we may with a single electrical equivalent make a plate as rapidly as by working at atmospheric temperatures with two batteries in consecutive order, with double surfaces, (four times the battery and twice the expense.)

But as Smee's laws require that, in forming a plate, certain mutual conditions of apparatus be maintained, it follows that alterations in one element or condition must be attended by corresponding changes in the others. Hence, if the temperature of the electrolyte be raised to a certain point, and the apparatus correspondingly adjusted, it is evident that, to avoid incessant adjustment, the original temperature must be maintained.

Thus, to avail ourselves of the advantages experimentally found from heating the solutions, an apparatus for steadily maintaining a high temperature in the electrolyte through several successive days becomes indispensable.

As the electrotype operations are not suspended at night, it is important that the heating apparatus should perform its office for at least twelve hours without supervision or replenishing its fuel; and its action should be sensibly uniform, during all the time, between successive replenishings.

Such an apparatus I have devised, and is now in use. A peck of charcoal furnishes fuel for twelve hours, and maintains 100 gallons of copper solutions steadily, at any required point between 100° and 200°.

With the above arrangement in use, I have made a large reverse or alto, and returned the original to the engraving department, in 55 hours from its being placed in my hands. This time included trimming the edges and the preparations to prevent adhesion.

Again recurring to Ohm's formula, the relative value of R to r was once more experimentally found. This gave R : r :: 1 : 4 or $Q=\frac{1}{1+4}=0.20$, a great improvement as compared with the first determination of R : r :: 1 : 19, or Q $\frac{1}{1+19}=0.05$. Having now made r so small compared with R, the size of the battery can be profitably increased until the result is about 0.24. Moreover, using a double arrangement

of cells with double surfaces, for a double effect, we now have $2\left(\frac{1}{1+4}\right)=\frac{2}{2+4}=0.40$. As the relative resistance of the electrolyte becomes now still smaller, we may yet more increase the battery surface until the result is nearly 0.5.

The electrotype has now ceased to be a mere experiment, uncertain, expensive, and slow. I have lately formed plates of most excellent quality, at the rate of 3 lbs. to the square foot, in 24 hours. This rate will require but two days to form one of our largest plates, having ten square feet surface, and one-eighth of an inch thick.

Actions in the electrolytic solution.

The quantity of the deposited metal is governed solely by the relations between the *quantity* of electricity passing through any solution and the amount of metal the solution contains. The usual supposition is, that the acid of the salt goes to one electrode and the metal to the other. It is now ascertained that no such mutual transfer takes place; for, while the acid is carried to the positive electrode, the metal is *not* carried to the negative electrode. Hence, however strong the solution on commencing the process, the negative electrode, by abstracting the metal in its vicinity, is soon surrounded with a weak solution. With a simple wire electrode, the exhausted solution surrounding the electrode is readily renewed by mere difference of specific gravity producing a flow. But, with large parallel plate electrodes, this rapid renewal of dense solution becomes impossible, and the electrode is soon surrounded with a weak solution. This state of things must be recognised in adjusting our battery arrangements. Electrotypists not aware of this fact find themselves much perplexed by failing to accomplish with large plates what is so easily done with medals or small plates.

It would, at first sight, appear that, by strengthening the solution of sulphate of copper, a more rapid supply of metal to the electrode would be obtained. Unfortunately, the effect of this is to diminish the solvent capacity of the water in the solution for the sulphate formed on the positive electrode by the action of the transferred acid. The grand essential in electrolysis is liquidity in the solution. Thus, if the quantity of free water surrounding the positive electrode be small, this electrode is soon enveloped in a saturated solution, and the newly-formed salt remains undissolved upon it. This salt, being a non-conductor, virtually excludes the electrode from the solution, and thus arrests the current, except when the efflux of saturated solution permits the salt to dissolve, and so reopens the passage for the current in irregular quantities. From this spasmodic action result plates of copper-sand, or sometimes copper as soft as lead.

By applying heat to the solution when this state of things exists, the solvent capacity of the water for the salt is increased, rapid diffusion takes place, the salt is carried to the negative electrode, and the exhausted water to the positive electrode; the dormant batteries rush into uninterrupted action, and in a short time a plate is deposited, having all the hardness and elasticity of hammered or rolled copper. Smee's conditions, then, seem to maintain themselves. The electrotypists'

axiom of "work slowly," requires to be reversed into "the quicker the work, the better the quality."

Laboratory apparatus.

Figure I is a plan of the coast survey electrotype laboratory. The glazed partition, *b*, *b*, *b*, *b*, with a door, *d*, separates the battery room from the general laboratory, and permits an easy inspection of the batteries, without exposure to their fumes. The laboratory floor is about six feet above the ground, and slopes inward from the sides towards the scuttle holes, *h*, *h*, *h*, *h*, arranged for discharging the waste liquids spilled upon the floor. To obviate the deleterious effects of working on a floor saturated with chemical agents, when any solutions are spilled, the floor is well flooded and brushed, the water passing off through the scuttle holes. There are four battery cells, placed as indicated, B, B, B, B. A rectangular India-rubber bag, supported by a deep wooden box, contains the battery solutions. Each cell can contain nine silver and eight zinc plates. A metallic connexion unites all the zinc plates of a cell, and another one all the silver plates. Each cell can be used as an independent battery, or two, three, or four cells can be connected in consecutive or simultaneous order, or all combined into two pairs of two in consecutive or simultaneous order, or into one group of three and one of one. The position of the vertical decomposing vat is shown at V, and that of the horizontal vat at H. S is a large tub for washing plates. The tub C contains the solution of chloride of iron. Q is the quicksilver tub, and W, W, are fresh water tubs. F is the furnace, and *d*, *d*, *c*, *c*, are heating tubes connecting with the vat H. T is a flat iron table.

Fig. 2 exhibits a cell and its included plates, with their mode of suspension.

Fig. 3 represents the suspending frame of wood and the attached plate, P, prepared for immersion in the vertical vat.

Fig. 4 shows the vertical vat and the plates suspended in it.

Fig. 5 represents the adjustable plate-supporting frame used in the horizontal vat.

Fig. 6 exhibits the interior arrangement of the horizontal vat, a blank plate and an engraved original being in position; also the connecting copper wires leading to the battery.

Fig. 7 represents the heating furnace. The door for admitting air is shown at *a*, and is so connected with an adjusting compound bar of iron and zinc that by an adjusting screw it can be arranged to regulate the draught, opening or closing the door, thus maintaining a uniform heat in the solution. After getting the fire started, this door is set so as to close when the solution reaches a heat of 150°. In principle this furnace is similar to a bath-heater. A tubular helix of lead is coiled within it like the worm of a still, and the terminating branches *c* and *d* lead to the horizontal vat, the branch *c* uniting the top of the vat just below the liquid surface with the bottom of the coil, and *d* the bottom of the vat with the top of the coil. Hence follows a circulation of the solution from the furnace at top and into it at bottom.

Manipulation.

When a plate is to be electrotyped, it is placed on trestles above the open scuttle holes, *h*, *h*, *h*, *h*, and thoroughly cleaned by washing with alkalies and acids. It is then silvered, iodized, and placed before a window. A plate of rolled copper an inch larger than the engraved plate is then selected, placed on the flat iron table, and beaten with mallets until a steel straight edge shows it to be plane. It is then weighed and fixed in the vertical plate frame by two copper hooks. The engraved plate is then similarly fixed in a similar frame, when both are placed in a vertical vat and connected with the battery.

The process does not go on well when the plates are vertical, but it is necessary to start the castings in this position to prevent dust, motes, or specks of impurities, from settling on the face. As the rolled plate dissolves, its impurities rapidly render the solution muddy, and endanger the face of the forming plate. For common electrotypes dust or mote specks are not detrimental; but the coast survey copper plates being not inferior in fineness of lines to fine steel plates, the effect of impurities settling on the face of their copies is to give the impressions a clouded appearance. On first immersing the plate, the solution should, therefore, be perfectly clean. Formerly, after each use of the vertical vat, it was emptied and washed out. When the solution had deposited its sediment it was drawn off and strained through very fine cotton. This whole operation was extremely disagreeable, and consumed a whole day of one man.

By a simple expedient I have saved the necessity of cleaning the vat oftener than once a month. To guard the new plate from specks and impurities, a bag of fine cotton is drawn over a slight wooden frame, which keeps it distended. An hour or more before the solution is wanted, the bag, with its included frame, is placed on top of the solution and loaded with the copper bars used to support the plate frames. The weight causes the bag to sink gradually, filtering the contained solution as it goes down. The impurities cannot wholly choke the meshes of the cloth, as a fresh portion is constantly brought into action during the sinking. I thus filter the solution without taking it from the vat or disturbing the sediment, saving much labor, time, and annoyance.

The plate remains in the vertical vat over night, and preparations are made in the morning to transfer it to the horizontal vat. The furnace is first brought into action. A new plate of blank copper, an inch larger than the matrix, is flattened on the iron table, and bolted to the edges of wooden bars by platinum bolts, for the purpose of preventing the plate from sagging downwards when supported horizontally. The plate so arranged is called the strapped plate. The coated matrix is then taken from the vertical vat, disengaged from its frame, and arranged in the horizontal frame. A wooden wall, an inch high, then surrounds the plate, and in this wall the strapped plate is laid, when the whole combination is placed in the horizontal vat and the connexion with the battery established. The positive plate is then taken from the vertical vat and its loss of weight noted and recorded. From the known superficial area of the matrix, the quantity of copper required for a casting one-eighth of an inch thick is computed and recorded. The

blank copper consumed in both vats must equal this amount before the required thickness is reached, allowance being made for impurities of rolled copper and roughness on the back of the electrotype. After a few hours of action the strapped plate becomes so loaded with impurities that they will begin to drop on the electrotype; this plate must, therefore, be removed from the vat and a new one immediately supplied. The dirty plate is then washed in the large water tub, and when cleaned its loss of weight is found and recorded. By the amount of loss the action of the batteries is tested, and it is found, if Smee's laws are being observed. Vigilance must now be exercised in watching the batteries and rate of work, and the power must be varied to suit circumstances.

The entire working battery generally requires renewal once a day, the process being conducted as follows: One zinc and one silver plate are taken from the battery; the silver placed in the solution of chloride of iron, and the zinc taken to the water tub outside the door of the battery room, where it is scrubbed clean with a hard brush. It is then re-amalgamated at the quicksilver tub, and taken back to the battery. The silver plate is transferred from the chloride of iron solution to the adjacent fresh water tub. Another silver plate is then transferred from the battery to the chloride solution, and another zinc cleaned, washed, and put back in the battery with the first silver. In this manner the whole battery can be renewed without sensibly interrupting its action.

When the loss of weight from the rolled copper in both vats indicates that the required thickness of the electrotype is gained, the plate is withdrawn from the battery, detached from its frame, its back smoothed, and its edges filed, until a separation can be made. By separation, the original becomes liberated, and the alto or reversed relief is silvered and electrotyped exactly as an original. The copy from it, or the electrotyped basso, will, if the process has been properly conducted, be a perfect fac-simile of the original, and in hardness, ductility, and elasticity, will equal the best rolled and hammered or planished copper plate.

Yours, respectfully,

GEORGE MATHIOT.

Major I. I. Stevens,
Assistant in charge of office.

APPENDIX No. 56.

Report of Lieutenant Washington A. Bartlett, U. S. N., assistant in the coast survey, to the Superintendent, on the examination of the reefs in Hell Gate channel, and changes produced by blasting.

New York, *December* 4, 1851.

Dear Sir: In my previous reports on the improvements being made in Hell Gate channel, by the operations of Mons. Maillefert, facilitated by advances from citizens of New York, I have endeavored to keep you advised of the progress of the work, and its probable effect in improving this important channel of ingress to New York harbor.

I am now enabled to lay before you *results actually* obtained, which

have substantially improved the navigation of the "Gate;" reduced the risk of passing through it; and which will very considerably modify the sailing directions which appear on the first edition of the coast survey chart of *Hell Gate*, and its approaches.

Referring to the reports made to you by Lieutenant Commanding Chas. H. Davis, United States navy, on the 15th February, and of Lieutenant Commanding D. D. Porter, on the 30th of October, 1848, the great advantages which they so ably discussed, and so confidently expected would ensue when the effort should be made as proposed, I am happy to say are now being realized.

A close attention to all they suggested as the basis of operations, and the exertions of Mr. Maillefert and Mr. Eben Meriam, based on those reports and surveys, have most conclusively demonstrated to me—so far as the work has progressed—the clear perceptions of those able officers in their suggestions for the improvement of the channel.

It only required Mr. Maillefert's effective method of overcoming the local difficulties involved in any attack on Pot rock to make the work effective. The results are altogether favorable. * * *

The first in order, and the principal obstruction in Hell Gate, is *Pot rock*, on which I found but eight feet of water at low tide; the average depth, however, was about ten feet; the rock at the least depth being about six feet square, deepening to fourteen feet on the east and west sides, and suddenly to four fathoms on the north and south. * *

At half tides the depth of water does not increase on Pot rock, as there is at least a fall of *four feet*, and a vessel drawing over eight feet must strike upon it. "A full-rigged brig struck it three days since, and went down with a valuable cargo on board."

This obstruction once removed, Hell Gate would be less dangerous by one-half, "and the eddies, which are now the cause of half the difficulties, would in a measure disappear."

I have quoted as above Lieutenant Commanding Porter, United States navy, for the purpose of saying that his observations have been most fully sustained by the present condition of *Pot rock*, and that the vast—I might almost say the incalculable advantages to be derived for all future time from the reduction of this rock, cause it to be considered by all who have occasion to pass through this channel as of inestimable value.

It cannot now be said that a vessel drawing only eight feet of water will strike, *for there are not less than eighteen feet* water on any part of the rock at low tide; and the prospect is highly favorable to the belief that M. Maillefert will soon have lowered it to twenty feet, a depth which in my opinion is amply sufficient for all the requirements of the Hell Gate channel.

The advantages derived from the increased depth of water on *Pot rock* are as follow:

1st. Vessels drawing sixteen feet water can pass over it with impunity at any time of tide, and any frigate in the navy can do so at *high water*.

2d. The increased facility for the passage of the rapid current of the flood-tide over the top of Pot rock prevents that high and violent ebullition of the water which formerly existed to the imminent danger of all

small vessels (though they might not hit the rock itself) which were thrown within its influence; while it prevents that rapid eddy, or *return current*, which formerly existed, and which threw all boats or "small craft" which once entered it into the very centre of the "Pot," and then engulphed them.

The dangers to be apprehended from these causes (or if averted, encountering others in avoiding them) compelled all mariners to so direct their course through the Gate as to give the "Pot" as wide a berth as possible; and this wide steering again produced other difficulties equally attributable to it, but which otherwise could be easily avoided. Lieutenant Commanding Porter justly said that, "*Pot rock* once removed, Hell Gate would be less dangerous by one-half, and the eddies, which are now the cause of half the difficulties, would in a measure disappear."

The sketches which have been furnished of my examinations of *Pot rock*, during the progress of its demolition, have shown that it is at a mean depth of twenty feet at low water, one hundred and thirty feet in length, and thirty feet in *average* width. Before blasting, the least depth extended over a surface six feet square, while the average depth (*vide* Lieutenaut Porter's report) was about ten feet. With these facts before me, I have estimated that not less than (30,000) thirty thousand cubic feet of rock (hard gneiss) have been broken up, and scattered from the upper portions of the rock, by firing two hundred and twenty sub-marine charges, of one hundred and twenty-five pounds each, *without drilling*. This is equal to one hundred and thirty-five cubic feet of rock being removed at each blast; which calculation agrees remarkably well with the effect of *each* blast at Pot rock, and other points where I have examined for facts.

If it had required a pound of powder to a *pound of rock*, it would be a *cheap* process at Pot rock; for it is not easy to conceive how this very troublesome obstruction could have been so far demolished by any other mode than that used. The strength of the current is an effectual opponent to any drilling, even supposing it possible, by successfully anchoring a *float*, the position could be maintained. It was ably attempted and signally failed. The few moments at slack water are not sufficient to find the drilling point, and only sufficient for firing two or three charges, previously arranged for firing, *without drilling*.

In another part of the report of Lieutenant Commanding D. D. Porter, he states to you as follows: "There is a small, though very dangerous rock to the southward of Woolsey's bath-house. It extends about fifty yards out into the channel, and is connected with the shore-line at low water. There are three feet of water on it at high tides. On the first of the flood, a buoy, let go opposite 'Gibbs's point,' (the southern approach to Hell Gate,) drifted round Hallett's point, between Pot rock and Way's reef, along the edge of the eddies, and over the above-mentioned rock, into 'Pot cove.' This happens to a great many vessels, and, but for this dangerous obstruction, they would drift into a safe harbor."

I have now the pleasure to report that this rock, so well described by Lieutenant Porter, and so dangerous that I have seen two vessels bilge on it within a single hour, and still another rock, which, though

not mentioned by him, lies a few yards from it, and nearly as dangerous and destructive, *have been entirely destroyed*, *annihilated by submarine explosions*, *without drilling*, since the 7th of November, and there are now not less than seven feet water at low tide where they existed, or the usual depth of water on the *shelving shore-line*.

These two rocks have been, for all the past time, very destructive to vessels attempting to pass the south shore, or in anchoring near it, when they were covered, which was most of the time; and any vessel once in the Pot Eddy in a calm was almost certain to hit one or the other of them. Three schooners have bilged on them this autumn. They no longer exist, and, if nothing else had been done to improve Hell Gate, their destruction is worth ten times the amount of money expended by the citizens in this enterprize.

Should masters of vessels now desire to anchor near the bluff to the southward of Woolsey's bath-house, they can do so without the risk of having their keels or rudders knocked out by the current swinging them on those rocks.

They can be erased from your next edition of the chart of Hell Gate.

Cram's rock, or rather the rock which lies *twenty-seven yards* from the end of Cram's dock, with a clear channel between it and the dock, as also "*Scalcy rock*" and "*Shell rock*," it is hoped, will be destroyed shortly, as they are always dangerous to vessels when the tide is above the half. The same can be said of the rock off "Negro point," "Bald-headed Billy,"* and "Blackwell's rock."

Cram's rock is in area ten by fifteen feet and ten feet high, (or above the bottom,) and covered at high water.

A few hundreds of pounds of powder will remove them all, and their destruction will save hundreds of thousands of dollars to the coasting trade.

My experience at *Hell Gate* during the past four months has shown me, in a strong light, (and I desire particularly to call your attention to it,) the force of the remark in Lieutenant Commanding Porter's report, already referred to, where he says: "If any attempt is made to carry out the recommendations that have been frequently made relative to clearing away rocks in Hell Gate, I would suggest a close examination of the shore-line at low water. Many rocks will be found to exist of a dangerous character, and they have at different times done much damage to vessels of light draught." He might have said, with equal propriety, that they are *continually doing damage*.

M. Maillefert has fired several discharges on the Frying-pan rock; but as the work is in progress, I shall not examine it till he closes for the season.

May's reef has also been the object of attack, as opportunity offered, and you have before you my careful examination of it in sections of three feet. As both these last-named dangers are in progress of removal, I shall not make further reference to them in this report. We have placed buoys at their extremities, which indicate their positions to navigators, and they are thus able to avoid them.

I must remark here that I have observed that, though most naviga-

* Removed Dec. 4, 1851.

tors knew certain marks for *avoiding* these hidden dangers of the Gate, very few indeed of the many who pass the Gate have had any clear idea of their *exact localities* until they witnessed the operations there.

Referring again to the able reports of Lieutenants Davis and Porter, I can only add, that it appears strange, indeed, that this great national thoroughfare should have been so long neglected by the country; for I cannot hesitate to say, that it often happens that there are not less than *two hundred* sail of vessels and steamers passing, or attempting to pass, *Hell Gate* at the same time, and all in this narrow channel of less than three miles in length.

A small amount of money for labor and contingent expenses, or two officers and ten men, with "*carte-blanche*" at a powder-mill, are all that are required to clear the navigation from Governor's island to Throg's neck; and there is no part of the navigable waters of the United States which requires it more.

The happy results of the operations in the Gate prove conclusively what was only speculation until attempted; and it is to be hoped that this good work will not stop for want of the trifling means to carry it on.

Numerous masters of the coasting trade have expressed to me their extreme gratification in the results already obtained; and, such is their anxiety to have it go on, that they would be willing to be taxed for every passage through the Gate if the dangers were removed.

The propriety of the work is too apparent, in the vastly growing commerce, by sail and steam, of this great city, to require any argument in its support. In conclusion, I beg leave to state, that to Eben Meriam, esq., is justly due the credit (and it is not a small matter) of interesting (by the aid of the reports in the coast survey office) the wealthy merchants of this city in this matter, and procuring from them the advances necessary for the experiment of this attempt at improvement in Hell Gate.

I deem it also proper to state, that M. Maillefert, the ingenious and enterprising operator in submarine blasting *without drilling*, exhibits the most ardent desire to serve the public to the utmost of his ability, preferring the *credit of success* in his novel mode of operation to any pecuniary benefit; and, notwithstanding all he has done, he will be a considerable *loser* in money, unless the benefits of his enterprise shall successfully appeal for his reimbursement.

I would remark, for your information, that the destruction of the two rocks, so troublesome on the south shore, was completed in less than one hour's time, and at an expense of less than one hundred dollars each.

I have received every possible assistance from Mr. Meriam and M. Maillefert, and their working force; and the free use of two metallic life and surf boats from Mr. Joseph Francis, for all my examinations under your instructions; and cannot close this report without adverting to the *great advantage*, and most *decided economy*, in the use of Mr Francis's metallic boats *at all times and in all places*.

His boats have been in constant use for months, *on* and around the rocks at Hell Gate, and are now in daily use, and *perfect order*, *without the expenditure of one cent for repairs*. No collision (by any exertion of

their crews) with the rocks hurts them, and we have purposely placed them directly over the charges of 125 lbs. of powder, and blown them up with the concussion of the water, without the slighest injury.

Respectfully submitted.

Your obedient servant,

WASH'N N. BARTLETT.

Prof. A. D. Bache,

Superintendent, Washington.

APPENDIX No. 57.

Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, upon an examination in reference to a light-house at Humboldt harbor, California, made by Lieutenant Commanding James Alden, United States navy, assistant in the coast survey.

Coast Survey Office,

November 19, 1851.

Sir: I have the honor to report, in conformity with the law approved March 3, 1851, and the instructions of the Treasury Department, that the examination of the necessity for a light-house at Humboldt harbor, California, has been made, and the following is the report of Lieut. Com. James Alden, United States navy, assistant in the coast survey, by whom the examination was made. A sketch of the recconnaissance is herewith enclosed.

"On the north spit I have marked the place where I think the light-house should be located. It is the nearest point to the entrance, and is, therefore, less liable to be obscured by fog; and, with a beacon further back, the two would form the best range to pass between the north and south breakers—not that it should be attempted in the night, unless under the most favorable circumstances. As Humboldt is rather out of the way of vessels passing up and down the coast, I have thought that a light of the second or third class would answer the purposes required at that point, and be sufficiently large for vessels bound in to maintain their position during the night."

I concur with Lieut. Com. Alden in the recommendation of a light of the third order, with a beacon light in rear, to give a range.

The department will decide whether authority exists to put up the proposed beacon as well as the light-house; and if not, I would respectfully request that an appropriation for it may be asked.

The tower of the light-house should be about twenty feet high, and the beacon be so placed that it will be still visible when running on the range line. It should be constructed so as to be moved without difficulty in case of a change in the interior.

Very respectfully, yours, &c.,

A. D. BACHE, *Superintendent.*

Hon. Thos. Corwin,

Secretary of the Treasury.

APPENDIX No. 57, *bis.*

Letter of the Superintendent of the Coast Survey to Hon. Joseph Grinnell, of the Committee on Commerce, H. R., communicating a report of Lieut. Bartlett, U. S. N., assistant coast survey, on the importance of a light-house at Humboldt harbor.

COAST SURVEY OFFICE,
January 24, 1851.

DEAR SIR: I herewith transmit, for the information of the Committee on Commerce, a report in relation to the importance of a light-house at Humboldt harbor, California, by Lieutenant Washington A. Bartlett, United States navy, assistant in the reconnaissance of the western coast.

Yours, respectfully,

A. D. BACHE,
Superintendent Coast Survey.

Hon. JOSEPH GRINNELL,
of the Committee on Commerce.

WASHINGTON, *January* 24, 1851.

SIR: For the information of the Committee on Commerce of the House of Representatives, on the importance of a light-house at *Humboldt harbor*, State of California, I have to state, that Humboldt harbor, although only *discovered* in April, 1850, is already a seaport of great commercial importance in the coasting trade on the western coast.

Humboldt harbor is an extensive sheet of water, of good depth, having an easily accessible entrance from the sea, of about one mile in width.

The bar, having three fathoms at low tide, is one and a half mile outside of the sand points which form the entrance to the harbor.

The sea-shore is low, the sea-side of the harbor being narrow sand points, but slightly elevated above the sea; and hence a light-house is of the first importance to point out the entrance and proper bearing for crossing the bar. Large settlements—Humboldt, Eureka, and Union Town—have already been established on Humboldt bay, whence a road of forty miles communicates with the rich and extensive gold region of the Trinity and Klamath rivers.

The valley, which is watered by the streams which flow into Humboldt bay, is of exceeding fertility, and densely timbered with valuable forest trees.

The steam propellers from San Francisco to Oregon touch at Humboldt, and, before a light-house can be built, there will be a semi-weekly line of steamers between San Francisco and Humboldt. The best position for the town can only be determined by a survey of the entrance.

Very respectfully, your obedient servant,

WASHINGTON A. BARTLETT,
Lieutenant U. S. N., Assistant Coast Survey.

Prof. A. D. BACHE,
Superintendent U. S. Coast Survey.

ALPHABETICAL INDEX.

M.

N.

O.

Errata in the list of Geographical positions, discovered after the report was printed.

Note.—Discrepancies of 0.01, arising from increasing the last figure by a unit, when the figure in the third place of decimals was 5, while in similar cases the 5 was dropped, are not noticed in this list.

						″		″
P. 168,	station	Quaker,	column	longitude,	read	57.32	for	37.34.
P. 169,	"	Pocasset,	"	latitude,	"	07.23	"	07.20.
P. "	"	"	"	longitude,	"	11.33	"	11.36.
P. 218,	"	Mt. Independence,	"	longitude,	"	53.04	"	53.07.
P. 304,	"	Maulden's Mt.,	"	latitude,	"	12.01	"	11.98.
P. 324,	"	Smith's Pt. Light,	"	longitude,	"	58.30	"	58.50.
P. 372,	"	Pt. Lookout,	"	longitude,	"	04.86	"	04.90.
P. 374,	"	Wolftrap,	"	longitude,	"	24.32	"	24.22.
P. 375,	"	C. Henlopen,	"	longitude,	"	44.55	"	45.55.
P. 378,	"	South Birch,	"	longitude,	"	10.51	"	08.51.

LIST OF ERRATA.

Page 11, line 8 from bottom, for reduced read recorded.

Page 17, line 32 from top, for VI read VII.

Page 33, line 4 from top, for Sebattis read Mount Independence.

Page 34, line 11 from bottom, for Liverpool read Greenwich.

Page 34, line 10 from bottom, for 39. 96 read 29. 96.

Page 36, line 21 from top, for Mason read Nason.

Page 92, line 15 from bottom, for Charles N. Schott read Charles A. Schott.

Page 378, line Longitude of South Birch, for 75° 10′ 08″. 51 read 75° 10′ 10″. 51.

Pages 553 to 558. The depth on Pot Rock was found, in the subsequent survey by Major Frazer, to be 18 feet, and, after additional blasting, three points of 19 feet 3 inches remained, December, 1852.

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